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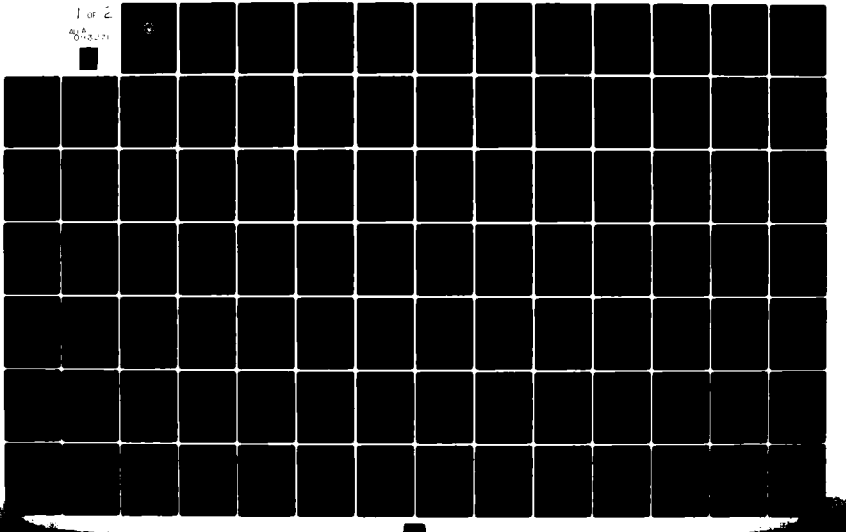

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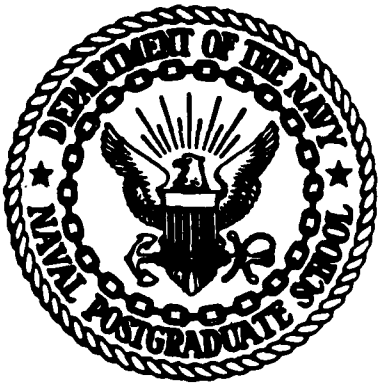

THESIS

ENERGY AS A FACTOR IN
THE ACQUISITION OF MAJOR
WEAPON SYSTEMS

by

Donald Richard McKenzie, Jr.

September 1980

Thesis Advisor: David V. Lamm

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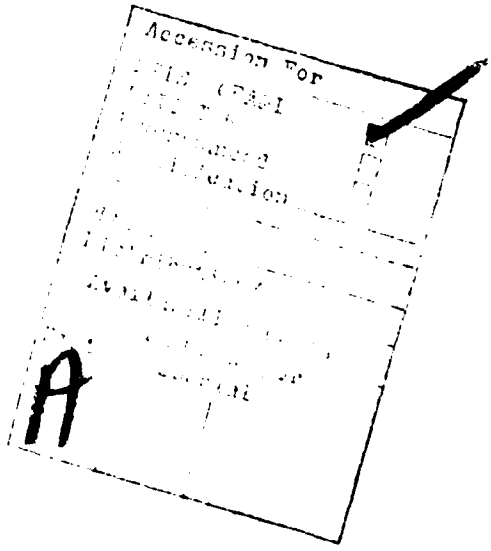

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Energy As A Factor In The Acquisition of Major Weapon Systems

by

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Submitted in partial fulfillment of
requirements for the degree of

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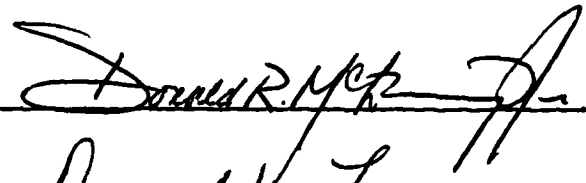
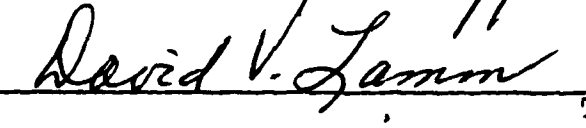
Author 

Approved by: 
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ABSTRACT

The focus of this research was to examine several critical factors attendent to the issues of energy conservation and efficiency in major systems acquisition as viewed by the U.S. Defense Aerospace Industry. These factors include energy conservation acquisition strategies, management programs and contingency plans. The research objectives were (1) to investigate how the Department of Defense (DOD) motivates Industry to conserve energy, (2) to examine Industry's views for conserving energy in the acquisition process and (3) to provide recommendations based upon Industry's views.

The results of the research indicate that selected acquisition concepts such as Life Cycle Costing, Value Incentive Clauses, Specifications and Profit, in addition to management programs and contingency plans, can effectively motivate Industry to conserve energy. The study's major contribution is that it presents the candid views of Industry for DOD consideration. Recommendations are presented to increase DOD's emphasis and support of energy conservation and efficiency in the acquisition process.

TABLE OF CONTENTS

I. INTRODUCTION

A. FOCUS OF THE RESEARCH

It has been seven years since the Arab oil embargo of 1973-74. In the interim, the United States and the rest of the world, have existed in a very unpredictable and energy-scarce environment that has been annually compounded by the increasing uncertainty of future energy shortages and rapidly escalating costs. These increases in the cost and scarcity of energy have had drastic effects on the U.S. economy and the National defense. The necessity and growing importance of conserving energy is being recognized and supported by Government, Industry and the American people in varying degrees, but there are a number of very critical and very complex issues that remain unresolved. One such issue requiring evaluation and resolution involves energy conservation and efficiency relating to the acquisition of major weapon systems. The focus of this research, therefore, is to investigate and evaluate selected factors attendent to the critical issues of energy conservation and efficiency relating to major weapon systems acquisition as viewed by the U.S. Defense Aerospace Industry. The selected factors to be reviewed involve the development and implementation of energy conservation acquisition strategies, management programs and contingency plans by Industry and an assessment

of the effectiveness and respective advantages/disadvantages of each. Government support (specifically within the Department of Defense) for these three very important issues will also be reviewed and critically analyzed. This study, based upon the views of the Defense Aerospace Industry, could provide a valuable contribution to the development of future Government acquisition strategies and techniques designed to enhance energy conservation and efficiency.

B. OBJECTIVES OF THE RESEARCH

The objectives of this study were: (1) to investigate and evaluate what has been done by the Department of Defense (DOD) to incentivize, motivate or require Defense Aerospace Contractors to conserve energy, (2) to investigate and determine the views of the Defense Aerospace Industry regarding the viability of certain acquisition strategies or techniques that could result in energy conservation related to the acquisition of major weapon systems, (3) to investigate what voluntary progress has been made to date by the Defense Aerospace Industry on the subjects of Energy Conservation Management Programs and Energy Crisis Contingency Planning, (4) to initiate increased visibility on the problem of energy conservation in the acquisition of weapon systems that will hopefully result in the future development and implementation of specific policies and procedures by which acquisition officials can operate, and (5) to develop conclusions and recommendations based

upon the research input received from the Defense Aerospace Industry via the researcher's Energy Questionnaire that should be considered prior to the development and implementation of these acquisition policies and procedures.

C. RESEARCH QUESTION

In order to accomplish the objectives of this research, the following research question and subsidiary questions were addressed:

1. What are the views of the U.S. Defense Aerospace Industry, regarding the Government's support and utilization of energy conservation acquisition strategies, management programs and contingency plans, in major weapon systems acquisition, considering the increasing importance and criticality of energy conservation and efficiency?

   a. In brief, what is the status of the energy situation in the United States today?

   b. What primary legislation and implementing instructions have been developed within the Department of Defense to address energy conservation in the acquisition of weapon systems?

   c. What does the Defense Aerospace Industry view as the viability, effectiveness and advantages or disadvantages of using the following Energy Conservation Acquisition Strategies (ECAS) to conserve energy in the acquisition process of weapon systems hardware:

      1. Life Cycle Costing
      2. Energy Efficiency Standards
      3. Design versus Performance Specifications
      4. Value Incentive Clauses
      5. Profit Considerations

   d. What voluntary progress has been made to date by the Defense Aerospace Industry on the issues of Energy Conservation Management Programs (ECMP) and Energy Crisis Contingency Planning (ECCP)?

   e. What conclusions and recommendations can be formulated and presented based upon the inputs of various contractors within the Defense Aerospace Industry so as to establish a foundation upon which future acquisition policies may be based?

D. RESEARCH METHODOLOGY

The data utilized and presented in this research effort was extracted from the current literature and the results of the researcher's Energy Questionnaire which was distributed to 69 contractors within the Defense Aerospace Industry. The Energy Questionnaire was very extensive and was carefully developed by the researcher to address questions relating to Energy Conservation Acquisition Strategies, Management Programs and Contingency Plans. Background information such as Government owned facilities, annual sales, business base and the contractor's specific energy situation was also requested and obtained via the questionnaire. In most cases, the scope of the questionnaire required the expertise of several personnel within the various contractor's organizations, primarily the Energy Coordinators (Facilities personnel) and the Contract Administrators.

The Energy Questionnaire and its numerical results are included in Appendix A. The qualitative results are discussed in Chapters IV, V and VI. Appendix A should be reviewed prior to reading these Chapters. The 69 Defense Aerospace Contractors were randomly selected by the researcher using sources such as the Defense Contract Administration Services organization and the Aerospace Industry Association. A total of 21 contractors (30 percent) responded to the Energy Questionnaire. The sample size and the response rate were not extensive but were considered by the researcher to

be adequate. The information received was considered to be representative of the entire industry. This data was clarified, expanded and supported in interviews that were conducted with four of the questionnaire respondents.

Most of the current literature was obtained through the use of data bases such as the Defense Logistics Studies Information Exchange (DLSIE) and the Defense Technical Information Center (DTIC). This researcher found that the topic of energy conservation relating to weapon systems acquisition was not discussed extensively in the current literature. The current literature utilized consisted of various DOD instructions and directives, reports by the General Accounting Office and the Logistics Management Institute and various articles in selected periodicals.

E. SCOPE OF THE STUDY

The scope of this study is essentially limited to energy conservation within the Defense Aerospace Industry related to the acquisition of weapon systems hardware. The views and recommendations of Industry on the topics of ECAS, ECMP and ECCP will receive primary emphasis. The role of the Government (specifically DOD) relating to pertinent legislation, directives and instructions will be discussed briefly. Further emphasis on the Government's role in energy conservation and weapon systems acquisition past, present and future will hopefully be addressed in future research efforts.

F. ASSUMPTIONS

It is assumed that the Defense Aerospace Industry and the Department of Defense both recognize the national importance of energy conservation related to the acquisition of weapon systems hardware. It is also assumed that the reader is generally familiar with the process of major system acquisitions (OMB Circular No. A-109), DOD acquisition terminology and DOD acquisition concepts such as Life Cycle Costing, Value Incentive Programs, Energy Efficiency Standards, Specifications and Profit Considerations.

G. ORGANIZATION OF THE STUDY

The study is organized to address all of the research questions in the sequence that they are listed. Chapter II provides background information pertaining to the current world and national energy situations, the energy outlook and various issues that have developed pertaining to energy conservation and weapon system acquisition. A framework to interface energy conservation and major weapon system acquisition is presented in Chapter III by discussing the major system acquisition process, pertinent legislation and general information on selected acquisition strategies. Chapter IV evaluates the viability of several energy conservation acquisition strategies based upon the input received from various contractors within the Defense Aerospace Industry via the Energy Questionnaire. General comments pertaining to the effectiveness and advantages or disadvantages

of these strategies will be addressed. Chapters V and VI discuss the progress made to date by the Defense Aerospace Industry on the issues of energy conservation management programs and contingency plans respectively and relate Industry's views concerning the necessity and relative success of these programs. Finally, Chapter VII presents conclusions based upon the results of the research and provides recommendations for improving energy conservation relating to weapon systems acquisition. Various appendices are provided to enhance or emphasize various aspects of the research and provide additional information for the reader.

II. BACKGROUND

A. WORLD AND NATIONAL ENERGY SITUATION

One of the central issues confronting the United States today is the energy problem. During the decade of the 1970's, the United States and the rest of the world, have gone from a period of feast to one of famine with regard to the availability of petroleum and natural gas. Considering the presently unstable situation in the Middle East, the increasing dependence of the United States on foreign oil supplies and their ever increasing prices and the uncertainty related to future energy shortages, the future of the world and this nation pertaining to energy is very precarious. How well the American people respond to this extremely important issue will have fundamental consequences for the the safety of the nation and the stability of the world. [40:6]

Following World War II, the substantial expansion of production throughout the industrial world was made possible due to the availability of cheap sources of natural energy. The use of oil increased dramatically and coal declined in significance. Oil was in surplus on the world markets and its price in the early 1960's was depressed at a rate of approximately $2.08 per barrel. So extensive was this surplus of oil that the development of the Organization of Petroleum Exporting Countries (OPEC) in 1960 was hardly noted. In 1967, the Suez Canal was closed and the periodical severing of the TransArabian pipeline served to increase tanker rates and definitely contributed to the development of today's super tankers. [40:6] The Yom Kippur War in October 1973 provided the catalyst for the Arab Oil Embargo of 1973. This embargo was declared by OPEC in 1973 on shipments of petroleum to the United States as well as to the Netherlands, Portugal and South Africa. [17:xv] With this action, OPEC declared a fourfold price increase effective 1 January 1974 and in essence created the "energy crisis". The era of cheap energy, for the United States and the rest of the world, was now history.

The current energy problems for the industrialized nations are basically petroleum problems. Petroleum has been the major energy source for most of these nations, accounting for 44 percent of total world energy consumption. [7:11] This petroleum problem stems from the fact that the

principal oil consumers are not the major oil producers and that the world's oil supplies are dwindling. The Third World Nations are the predominant oil producers, with Africa and the Middle East presently producing 46 percent. [7:11] Communist countries produce approximately 21 percent of total world supplies with the highly industrialized nations producing about 22 percent. It is very important to note that the highly industrialized nations are the world's major oil consumers, accounting for approximately 75 percent of total world oil consumption. This consumption when compared to a production rate of only 22 percent has serious strategic implications.

The strategic significance and implications relating to the energy problem are caused in part by the geological distribution of proved crude oil reserves. Over 46 percent of these reserves are located in Africa and the Middle East, 32 percent in Mexico, ten percent in Communist countries, seven percent in the United States and five percent in other Third World Countries. [7:12] Approximately one-third of the reserves in the United States come from Alaska. The locations of these oil reserves have made the United States and other industrialized nations dangerously dependent on energy supplied by Third World Nations. In 1978, U.S. imports of petroleum and petroleum products accounted for 48 percent of domestic consumption. [7:13] This high degree of dependence on foreign oil is novel in U.S. history and has

made it extremely vulnerable to a wide range of economic and political threats. The high cost of oil, the resulting affects on the dollar and the U.S. economy and the uncertainty of supply interruptions have definitely hurt the United States as well as the economies of other Western industrial nations. [26:58]

The dependence of the industrialized countries on imported oil poses several inter-related issues. The most serious of these is supply vulnerability. If hostilities between the U.S. and its allies and the USSR would develop in the future, the USSR would attempt to cut off the flow of oil from the Middle East to the U.S. The U.S. would have the very unenviable task of protecting the sea lanes against a formidable array of Soviet submarines, bombers and surface ships. This supply vulnerability presents an unacceptable situation to national security. [40:8] Future embargos by OPEC must also be considered. An embargo of any significant duration would have serious economic effects on the industrial countries. As the demand for oil increases, future price rises by OPEC are an absolute certainty. Given that the world's oil reserves are finite, world oil production will decline at some point in time in the absence of massive new discoveries. This decline in the availability of world oil will also give rise to additional price pressures. [40:8] These issues require the joint consideration of the United States and other industrial nations in order to effectively cope with the energy problems that lie ahead.

There are no quick and certain solutions to the energy problems facing the United States today. The American prople's awareness and support of the necessity to increase energy conservation, increase energy efficiency and develop future energy crisis contingency plans must be accelerated. A coherent national energy policy must be formulated, enacted by Congress and vigorously implemented. Both Government and industry must increase their efforts toward energy conservation and efficiency. The Department of Defense is the nation's single largest user of energy, consuming approximately 1.8 percent of the U.S. total annual consumption in FY 1978. [8:3] It is estimated that an additional five to six percent is used in the production, operation and supply of the thousands of items of military hardware on which the military forces are dependent. Of the total defense energy consumption in FY 1978, the Navy and Marine Corps consumed 32 percent, the Air Force 50 percent and the Army 18 percent. [8:3] On the other hand, the industrial sector is the largest of the Nation's energy consuming sectors accounting for approximately 38 percent of U.S. energy use in 1975. [30:18] It appears that significant potential for energy conservation and efficiency exists throughout the Government (specifically DOD) and U.S. industry. While the Department of Defense has initiated numerous "in-house" programs aimed at increasing energy conservation and efficiency, little progress has been made in influencing conservation in the commercial sector. [22:69]

Presently, little or no Government incentive exists to stimulate contractors to be energy conscious and no corresponding measurement is taken on contractors' progress or compliance with national energy conservation objectives. [27:63-92]

As previously stated, the energy problem is one of the central issues confronting the United States today. The energy outlook for the decade of the 1980's will be a grim race between the depletion of existing hydrocarbon sources, conservation and efficiency efforts and research and development of new energy sources. Considerable uncertainty exists relating to future supply disruptions and future increases in the cost of energy. However, considering its impact upon the economy, national security and world stability, it appears that the energy problem should be given top priority by the American people, the Government and American Industry.

B. THE ENERGY OUTLOOK AND OPTIONS

During a recent symposium held in San Francisco in January, 1980 at the annual meeting of the American Association for the Advancement of Science, the energy outlook for the 1980's was discussed. The following are summaries of several points that were discussed. The following are summaries of several points that were made at the meeting: [12:40]

1. Much concern was expressed over how the United States has wasted the seven years since the 1973 oil embargo in excessively long and unproductive debate over policy.

2. Because of these delays the United States will continue to be heavily dependent on highly vulnerable supplies from OPEC.

3. The probability of major disruptions in these oil supplies and the chance of war due to these

disruptions are considered to be high during the next decade.

4. The world availability of oil is finite and is decreasing. Future shortages will keep prices spiraling upward and tend to exacerbate any crisis.

5. The outlook for nuclear power is clouded. The use of coal will increase but synthetic fuels will not be a major factor in the next 10 years. A switch to renewable sources such as solar energy cannot be made fast enough to be a significant factor during the 1980's.

6. The United States will continue to teeter on the brink of catastrophe throughout the decade with the possibility that it might go well over the brink.

These comments were consistent with the title of the article in which they appeared, "1980's Energy Outlook: Gloom and Doom." However, the individuals who attended this meeting presented what they considered to be frank, candid and realistic remarks about the energy problems currently facing the United States. Mr. John O'Leary, former Deputy Secretary for the Department of Energy stated that the United States had dissipated the last decade. [12:41] He stated that "the payday for this delinquency will be horrible to contemplate" and sees the next decade as one of "unmitigated gloom." Rep. Richard Ottinger (D.-N.Y.) says that "the present trend of higher energy costs, sporadic crisis and transient accommodations will continue" and he described U.S. energy policy to date as "fumbling."

During 1979, three detailed studies examining U.S. energy demand and supply opportunities and the policy options to accommodate them most effectively were published and then analyzed and compared. These studies are as follows:

1. Energy Future: Report of the Energy Project at the Harvard Business School. ("The Harvard Study"). [25:1]

2. Energy: The Next Twenty Years, sponsored by the Ford Foundation and administered by the Resources of the Future, ("The Ford Study"). [14:1]

3. Energy in America's Future: The Choices Before Us, sponsored by the Staff of the Resources for the Future, National Energy Strategies Project ("The RFF Study"). [24:1]

All three of these studies discuss the energy problems that will be faced by the United States in the future and present various policy options that might be viable methods of handling these problems. These studies were analyzed and compared by Paul L. Joskow in an outstanding article prepared for National Economic Research Associates and published in the Bell Journal of Economics. [13:377-398] This analysis provides an excellent summary of the energy outlook for the United States during the decade of the 1980's and beyond.

The Harvard Study received much more attention than either the Ford or RFF Studies. It has been cited frequently in the press and by a variety of congressmen. [13:377] The following are the summaries of the major points presented by the Harvard Study: [13:378-380]

1. The U.S. is becoming increasingly dependent on foreign oil supplied by countries that are politically unstable. This will involve substantial economic and political costs for the U.S.

2. Even if oil prices are decontrolled, domestic petroleum production cannot be expected to increase beyond current levels. At best, the U.S. shall be able to maintain current levels of petroleum production over the next ten to 20 years.

3. Even if natural gas prices are decontrolled, natural gas production cannot be expected to increase beyond current levels. At best, the U.S. shall be able to maintain current levels of natural gas production over the next 10 to 20 years.

4. Coal production and consumption will increase over the short and medium term but at a far slower rate than anticipated due to environmental, transportation, managerial and labor problems that must gradually be resolved.

5. Nuclear power is stalemated because of safety, environmental and cost problems and cannot be relied on to provide much more than another million barrels per day of oil equivalent in the next decade.

6. It is unreasonable to expect that the U.S. shall be able to increase domestic production from conventional sources very much if at all during the rest of this century. "Unconventional sources" such as shale oil, coal liquefaction and coal gasification are characterized as being prohibitively costly and plagued by environmental problems although future Government research support is encouraged.

7. The basic problem with the U.S. energy policy is its excessive reliance on devising mechanisms to increase supplies of conventional fuels and on the promise of new supplies from unconventional energy sources. If the U.S. continues business as usual, it is inevitable that its reliance on foreign oil will increase and this will impose substantial economic, political, social, and environmental costs on the economy.

8. Conservation appears to be the most attractive "energy supply" source of all, but its progress is being slowed by economic and institutional barriers. These include low energy prices, residential consumer ignorance, "shortages" of capital in business and industry due to rate of return criteria that are "too high," failure of the Government to provide leadership and electric utility policies that discourage cogeneration.

9. Solar energy is another attractive "energy supply" source but it is also experiencing the same economic and institutional problems cited for conservation.

10. The Nation needs a "balanced" energy program to give conservation and solar energy a fair chance.

Policy initiatives proposed by the Harvard Study are as follows: [13:380-381]

1. Stronger automobile efficiency standards, which do not hamper flexibility and experimentation, should be set for the post-1985 period.

2. In the industrial sector, investment tax credits and accelerated depreciation of up to 40 percent of capital costs should be allowed to encourage conservation and shifts to "alternative" energy sources.

3. For the residential-commercial sector, investment tax credits of up to 50 percent should be allowed to encourage investments in conservation. The electric utility industry should be charged with "delivering" conservation.

4. Those who install solar energy facilities should be given an "offsetting payment" of 60 percent of the capital cost. The utility industry should be responsible for delivery and financing.

5. Institutional barriers such as electric utility policies which discourage cogeneration and solar energy, property rights to sunlight, and the lack of standardized building codes should be eliminated.

6. A windfall profits tax should be imposed on "old" oil to pay for these programs and the price of "old" oil should be gradually deregulated when such a tax is imposed.

7. The government should assume leadership to promote conservation and solar energy to overcome all of the interest groups and "experts" who insist on leading the country down the wrong path.

The Harvard Study has a number of strengths and weaknesses which are discussed in the Joskow article but it does provide some excellent data regarding the energy future of the United States.

The Ford Study provides a detailed assessment of energy supply and demand and states that with appropriate "new"

public policies the U.S. economy can adapt faster to increases in oil prices and reliance on foreign oil than by following prevailing public policies. The study group identifies and discusses a set of "realities" that it believes will characterize the production and consumption of energy over the next 20 years. Understanding these realities is presented as the key to recognizing and solving future energy problems. These "realities" are as follows: [13:385-389]

1. The world is not running out of energy. The Ford study quickly disposes of the myth that the energy problem over the next few decades derives from the prospect of a physical shortage of energy resources. The current energy problem does not lie in physical resource limits. It lies in a too heavy dependence on one or two sources of energy, in an unwillingness to face up to change, and in a fear unjustified by the facts that the costs of change will be unmanageable.

2. Middle East oil holds great risks, but is so valuable that the world will remain dependent on it for a long time. The study group feels that it is a mistake to believe that the U.S. and its allies can or should try to reduce oil imports by so much over the next 20 years that the cost and risk of supply interruptions would be eliminated. Efforts to ease the world oil supply-demand situation can reduce the dependence, but only slowly and at a high cost. The U.S. and its allies must "position" themselves to cope with sudden interruptions.

3. Higher energy costs cannot be avoided but can be contained by letting prices rise to reflect them. The general perspective of the study is that higher energy costs are a fact of life and reflect the marginal opportunity costs of extracting the physical resources that exist. The study goes to great lengths to show that with proper management, higher energy costs need not have a substantial effect on economic welfare or lifestyles in the United States or elsewhere. Since higher energy costs are a fact of life, price control efforts by the government cannot counteract them.

4. Environmental effects of energy use are serious and hard to manage. The study emphasizes that many energy-related activities damage or threaten to damage human health and the environment.

5. Conservation is an essential source of energy in large quantities. Conservation is viewed here primarily as a rational economic response to higher energy prices. It is an incremental "source" of energy because reduced energy consumption means that less energy from other direct supply sources is needed to equate supply and demand.

6. Serious shocks and surprises are likely to occur. The primary shock that seems to be of concern is associated with instability in the world oil market. Sudden reductions in supply and/or sharp increases in prices can occur with relatively little warning. The study correctly finds that U.S. policy remains ill-prepared to deal effectively with such shocks.

7. Sound R&D is essential, but there is no simple "technical fix." The study makes it clear that there is no simple technical fix for dealing with the energy problem and that popular analogies to the space program and military programs are largely irrelevant to the energy problems that confront us. The study group emphasizes the critical role the private sector has played and will play in research, development, demonstrations, and deployment. The object is to develop less costly ways of producing and consuming energy, not many more ways of processing and conserving energy, many of which may cost more than the energy they replace and will, therefore, never be adopted by consumers or producers without uneconomic subsides. The Ford study sees a primary role for the government in supporting basic research, creating basic knowledge about new technologies as well as basic research aimed at a better understanding of economic, political and legal institutions.

Policy initiatives proposed by the Ford Study include the following: [13:390-393]

1. Decontrol oil and gas prices.

2. Make utility prices to consumers better reflect real economic costs.

3. Use science and technology to generate and define basic options, while relying primarily on the private sector to develop and deploy technology.

4. Adopt a different approach to air pollution. The report is very critical of the current approach to air pollution. The program is too rigid and tends to lead to decisions which are too costly and do not adequately cope with air pollution.

5. Prepare for disruption in world oil markets.

6. Continue to reduce problems associated with nuclear power.

7. Work to improve the acceptability of coal.

8. Vigorously pursue conservation as an economical energy source.

9. Remove impediments to use of solar energy.

The Ford Study is described by Joskow as an excellent piece of work deserving more attention than it has received thus far. [13:395] The framework, analysis and conclusions form a basis for public policy pertaining to energy "realities" that the U.S. will have to cope with in the future.

The Ford Study and the RFF Study are very similar, however, Joskow states that the RFF Study is superior with regard to its empirical analysis which is more comprehensive and better documented.[13:395] The RFF Study emphasizes the economic characteristics of alternative energy supply opportunities and the energy consumption decisions that residential, commercial and industrial consumers can make. In the area of energy conservation, the RFF Study investigates in empirical detail the conservation potential of residential comfort heating, automotive transport and industrial process steam (with

emphasis on cogeneration). It is very optimistic about the conservation opportunities that exist in these areas.

The following policy recommendations are made by the RFF Study: [13:398]

1. Pricing, including deregulation of oil and gas prices and marginal-cost pricing of elasticity, is essential.

2. Regulatory policies must be reformed so that coal and nuclear energy can make economic contributions to the nation's energy supply/demand picture.

3. U.S. research and development policy must be reformed, including subsidies for synthetic fuel demonstration plants.

4. Consumers must be given more information on energy conservation opportunities and the Government should "push" conservation more than it is doing now.

5. Financial and institutional barriers should be eliminated that keep consumers from making rational conservation decisions.

6. Solar energy is a viable alternative energy source, however, it should not be looked upon as a "quick fix." Solar utilization should not be forced with the use of massive subsidies since that would be inefficient in the short run and might retard the development of solar energy technology in the long run.

This researcher found that these three studies represent the most current and most informative discussion available in the current literature on the energy future of the United States and its various options. The Harvard Study emphasizes the importance of conservation and solar energy, whereas, the Ford and RFF Studies include these options with other important factors. In general, all of the studies emphasize the following: [13:398]

1. Energy conservation is imperative.

2. Energy pricing reform is necessary.

3. Environmental policy reform is necessary.

4. Reduction of barriers to allow more extensive use of coal, nuclear and solar energies is required.

5. Research and development policy improvements are required.

6. Preparation for short-run energy emergencies is essential.

The researcher observed that these studies indicate that the time for policy making is over. It seems imperative that the United States should vigorously begin implementing the policy that it has taken seven years to establish. These studies indicate that steps must be taken to explore alternative sources of energy, increase energy conservation and in the long term reduce U.S. reliance on foreign oil. Although most experts will disagree with the exact date that the world's energy reserves will be exhausted, most will agree that those reserves are finite and are dwindling rapidly. Action must be taken now by all concerned to avoid probable catastrophes of the future.

C. ISSUES OF ENERGY CONSERVATION AND MAJOR SYSTEM ACQUISITION

The Department of Defense (DOD) and U.S. Industry are heavy energy consumers. As previously discussed, DOD consumed approximately 2 percent of the total U.S. energy consumption in FY-1978 and the industrial sector accounted for approximately 40 percent. Both DOD and the industrial

sector (specifically the Defense Industry) possess considerable energy conservation potential. By increasing energy conservation awareness and promoting energy efficiency, considerable energy and defense dollars could be saved. Various in-house programs exist within DOD to enhance energy conservation and efficiency, however, little has been done by DOD to incentivize and motivate the Defense Industry to do the same. [22:69] The acquisition of major weapon systems by DOD from the Defense Industry definitely possesses significant energy conservation potential. [32:1]

Although some would argue that the purpose of the acquisition process is to procure quality goods and services at fair and reasonable prices and not to support and help accomplish the Government's socioeconomic objectives, the reality of the situation does not prove this to be true. It seems only logical that the acquisition process, which was designed to meet the needs of the Government and safeguard the expenditure of public funds, should help to promote and enhance various objectives designed to protect the source of those funds - namely the taxpayers. DOD, through its annual expenditure of billions of dollars on defense, is in an ideal position to motivate defense contractors to conserve energy. This effort could be accomplished through the use of various energy conservation acquisition strategies and by encouraging the development of energy conservation management

programs and energy crisis contingency plans. Theoretically, this approach sounds fantastic, but the problems lie in the implementation.

The researcher's observation is that the following appear to be the primary issues related to using the acquisition process to enhance energy conservation:

1. It has taken the United States seven years to develop policy pertaining to the energy problem. Legislation and implementing regulations and directives do exist requiring the consideration of energy as a factor in the acquisition of major systems. However, these regulations are very general and very vague regarding the implementation of this policy. Within DOD, this researcher could not find any specific procedures promulgated for Contracting Officers to follow in considering energy in the acquisition process and as a result it is not being done.

2. Within DOD, energy conservation in the acquisition process is not being given top management support. Program Managers are not giving energy conservation the priority it deserves if it is receiving any priority at all. This is primarily due to the lack of specific implementing instructions on the subject.

3. By using the acquisition process as a vehicle to enhance energy conservation, it could cost the Government more than the value of the energy saved. The required paperwork and reporting requirements necessary to develop, implement and monitor the energy conservation progress of the Defense Industry could be extremely costly.

4. More accurate and complete information is needed on energy conservation costs and benefits. This lack of information has undoubtedly slowed Government action in this area and has also caused a lack of incentive for Defense contractors to improve their energy efficiency.

5. The high costs of facilities and equipment and their long lives is an impediment to energy conservation for most defense contractors. The small amount of profit realized on defense contracts is not enough to stimulate the capital investment necessary to finance energy efficient facilities and equipment.

6. There are limited dollars available for defense spending. Even though problems such as energy conservation and productivity are of national importance,

the Government has not sufficiently demonstrated the willingness to assist defense contractors in financing energy efficient investments.

7. There are a variety of acquisition strategies available that could be used to emphasize and enhance energy conservation in the acquisition process. However, there is a lack of concensus within Government and industry as to which strategy(s) would be viable to promote energy conservation and efficiency.

All of these issues must eventually be addressed if energy conservation and efficiency is to be considered in the acquisition process of major weapon systems. Since the focus of this research involves investigating the views of the Defense Aerospace Industry on energy conservation and systems acquisition, several of these issues will be discussed in subsequent chapters.

III. FRAMEWORK

A. THE MAJOR SYSTEMS ACQUISITION PROCESS

In April 1976, the Office of Management and Budget (OMB) issued OMB Circular A-109 entitled "Major System Acquisitions." The purpose of this circular was to establish policies and guidelines for executive agencies to follow in the acquisition of major systems. [20:1] The systems to which this policy applies include, but are not limited to the acquisition of Federal Office Buildings, transportation systems and defense and space systems. This discussion will pertain to the acquisition of major weapon systems for defense. In August 1976, the Office of Federal Procurement Policy (OFPP) issued OFPP Pamphlet No. 1

entitled "A Discussion of the Application of OMB Circular No. A-109." This OFPP pamphlet discusses the major system acquisition process and is very informative for those readers not familiar with the process.

OMB Circular A-109 and the policy cited therein is consistent with the recommendations made by the Commission on Government Procurement and requires the following: [18:2]

1. Top level management attention to the determination of agency mission needs and goals.

2. An integrated systematic approach for establishing mission needs, budgeting, contracting and managing programs.

3. Early direction of research and development efforts to satisfy mission needs and goals.

4. Improved opportunities for innovative private sector contributions to national needs.

5. Avoidance of premature commitments to full scale development and production.

6. Early communication with Congress in the acquisition process by relating major system acquisitions to agency mission needs and goals.

The sequence of events included in the major system acquisition process, as well as, the various milestones and decision points involved are presented in Appendix B, Figures 1 and 2 respectively. This acquisition cycle is common to all major programs even though no two programs are identical. The basic cycle involves a mission analysis designed to meet a certain threat, followed by exploration of alternative systems, validation and demonstration (including competitive demonstrations), full scale

development, test and evaluation, production and finally deployment and operation. The major milestones or decision points that occur during this acquisition cycle are identified by the circles numbers 1, 2, 3, and 4 in Figure 1 of Appendix B. They are further described in Figure 2 of Appendix B. These four milestones pertain to approval of the Mission Element Need Statement (MENS), selection of a system(s) for demonstration and validation, selection of a system(s) for full scale development and finally, release of the system(s) for production.

The first phase of the acquisition cycle involves the assessment of a mission need to counter a perceived threat. This mission analysis and evaluation and reconciliation of needs in view of the agency's mission, resources and priorities culminates in the submission of the MENS to the Secretary of Defense (SECDEF) for approval. This decision by the SECDEF is referred to as Milestone 0 on Figures 1 and 2 of Appendix B. Following approval of the MENS, the need is communicated to Congress to permit Congressional discussion of the need early in the acquisition cycle prior to the commitment of major resources and the selection of potential solutions. [18:7]

The approval of the MENS allows the agency components (i.e., Army, Navy, Air Force) to proceed with the exploration of alternative system design concepts. During this exploration phase, a program manager is usually assigned to manage

the new system and an acquisition strategy is formulated. Solicitations are widely distributed to industry to request design concepts that address the mission need. The proposals received from industry are carefully evaluated and the most promising are selected for further development. Parallel short term contracts are issued to evaluate the risk and feasibility of the design concepts. The system(s) that appears promising is again submitted to the SECDEF for decision via the Defense System Acquisition Review Council (DSARC) by means of the Decision Coordinating Paper (DCP). This decision point is referred to as Milestone I or DSARC I and includes a reaffirmation of the mission need and program objectives by SECDEF. The DCP approval by SECDEF at Milestone 1 releases the selected system(s) into the validation and demonstration phase. [18:9]

During the validation and demonstration phase, prototype demonstration contracts are issued and the selected design concepts are demonstrated and evaluated. This phase allows critical review of the performance of the design concepts involved and provides a basis for the selection of the concept(s) that will continue into full scale development. This decision is again made by SECDEF via the DSARC by means of the DCP and is referred to as Milestone II or DSARC II. SECDEF approval at Milestone II releases the chosen system for full scale engineering development, test and evaluation (FSED, T&E).

The contractor(s) and the weapon system(s) selected for FSED. T&E were evaluated on the basis of (1) the systems performance measured against mission need and program objectives, (2) the remaining risks and possible resolutions and, (3) the estimated acquisition and ownership costs. [18:18] During this phase, the program manager and his staff carefully monitor the contractor's progress related to cost, schedule and performance. Initial production units are manufactured, tested and evaluated in their normal operating environment to ensure effective performance under normal operating conditions. The testing and evaluation is done independent of the agency's development and user organizations. Full scale production proposals are developed and submitted by the contractors involved during FSED, T&E to provide data that can be utilized to make the production decision. This decision is again made by SECDEF via the DSARC by means of the DCP and is referred to as Milestone III or DSARC III. SECDEF approval at Milestone III releases the system(s) into full scale production and deployment. The phases of production, deployment and operation, and finally disposal, complete the major systems acquisition cycle. As technology and time march on, new threats are perceived and old systems become obsolete. New systems are required to meet the threat and the acquisition cycle begins again.

B. LEGISLATION AND REGULATIONS

Current legislation requires that energy conservation and efficiency be considered in the acquisition cycle.

A chronology of pertinent legislation and other related documents is presented in Appendix C and a list and brief explanation of various DOD directives is presented as Appendix D.

The Energy Policy and Conservation Act (EPCA), Public Law 94-163, dated 22 December 1975, introduces the issue of energy considerations in the acquisition cycle, as well as, energy conservation by private industry. The Act requires the following: [29:Sec. 381]

> The President shall, to the extent of his authority under other law, establish or coordinate Federal agency actions to develop mandatory standards with respect to energy conservation and energy efficiency to govern the procurement policies and decisions of the Federal Government and all Federal agencies and shall take such steps as are necessary to cause such standards to be implemented.

The Act also calls for the Administrator of the Federal Energy Administration (FEA), now the Department of Energy (DOE), to maintain and establish programs to promote energy conservation throughout American industry. [29:Sec.372] This involves the expansion and continuation of the voluntary industrial energy conservation program in effect since 1973-1974 in addition to the establishment of voluntary energy efficiency targets. The 10 most energy consumptive industries in the United States were required to submit annual reports to the FEA Administrator in order to evaluate the progress made towards energy conservation. It should be noted that although these reports were required, the basic philosophy of Section 372 is to foster, extend and encourage the development of the existing voluntary energy conservation and efficiency program. [23:101]

On 13 April 1976, President Ford issued Executive Order 11912 that pertained to the delegation of authorities related to the EPCA. Section 3 of this Executive Order states that: [39:114]

> The Administrator of the Office of Federal Procurement Policy, in the exercise of his statutory responsibility to provide overall direction of procurement policy (41 U.S.C. 405), shall, after consultation with the heads of appropriate agencies including those responsible for developing energy conservation and efficiency standards, and to the extent he considers appropriate and with due regard to the program activities of the Executive agencies, provide policy guidance governing the application of energy conservation and efficiency standards in the Federal procurement process in accord with section 381 (a)(1) of the Energy Policy and Conservation Act (89 Stat. 939, 42 U.S.C. 6361 (a)(1)).

Policy letter No. 76-1 was issued by the Administrator of OFPP on 6 August 1976 to implement Executive Order 11912. This policy letter is presented as Appendix E. The subject of the policy letter was "Federal Procurement Policy Concerning Energy Conservation." The Heads of Executive departments and establishments were required to ensure that: [19:1]

> . . . the principles of energy conservation and efficiency are applied in the procurement of property and services whenever the application of such principles would be meaningful and practicable and consistent with agency programs and operational needs. These principles may be appropriate, along with price and other relevant factors, in the formulation of purchase requests and solicitations and during the evaluation and selection of bids and proposals.

The policy letter also stated that specific procedural implementation of this policy would be promulgated in the

Armed Services Procurement Regulation (now the Defense Acquisition Regulation (DAR))and the Federal Procurement Regulation.

Discussions pertaining to the inclusion of language into the DAR relating to energy conservation and efficiency began in August 1976 and were concluded in February 1977. [21:1] The details of these discussions and the documentation associated therewith are included in DAR Case File No. 76-133 for the interested reader. On 29 April 1977, the following clause was inserted into the DAR: [2:1-339]

> 1-339 Energy Conservation
> (a) The Energy Policy and Conservation Act requires that Federal Procurement Policies governing requirements determinations and source selection decisions provide for consideration of (i) conservation of energy and (ii) the relative energy efficiency of alternative goods or services capable of satisfying the Government's needs.
> (b) The Energy conservation and energy efficiency criteria shall be applied in the determination of requirements and source selection decisions whenever the application of such criteria would be meaningful, practical and consistent with agency programs and operational needs. Under this policy, energy conservation and efficiency criteria shall be considered along with price and other relevant factors in the preparation of solicitations, the evaluation of offers and the selection of bids and proposals for award.
> (c) With respect to the procurement of consumer products, executive agencies, shall take cognizance of energy use efficiency labels and prescribed energy efficiency standards as they become available.

The legislative and policy considerations of energy conservation and efficiency are implemented into the DOD weapon system acquisition cycle by several key directives and instructions the majority of which are cited in Appendix D. The key DOD documents that link the major systems

acquisition policy cited in OMB Circular No. A-109 with energy conservation policy are DOD Directive, (DODD) 5000.1, Major System Acquisitions and DOD Instruction (DODI) 5000.2, Major System Acquisition Procedures. Both of these documents are dated 19 March 1980 and reflect recent changes and updates. DODD 5000.1 simply implements the policy cited in OMB Circular No. A-109 and DODI 5000.2 provides the procedures to be followed in the implementation. There are several paragraphs in DODI 5000.2 that can be related to the subject of energy use and the costs associated therewith. Affordability, Socioeconomic Program Implementation, Design Considerations and Logistics will all be effected by energy considerations. Paragraph 8(e) entitled "System Energy Requirements" states that: [6:15]

> Energy requirements shall be considered in system selection and design. Major considerations shall be minimum energy usage and the substitution of other energy sources for petroleum and natural gas.

Enclosure (2) to DODI 5000.2 pertains to the format of the MENS. Paragraph E(4) of enclosure (2) states that "logistics, safety, health, energy, environment and manpower considerations" shall be reviewed and evaluated as possible constraints of the mission element need. [6:2 encl (2)]

Enclosure (4) to DODI 5000.2 pertains to the format of the Integrated Program Summary (IPS). The IPS summarizes the implementation plan of the DOD component for the complete acquisition cycle with emphasis on the phase that the

program is entering. Topic No. 21 of the IPS pertains to energy, environment, health and safety and requires specifically for energy considerations that the DOD component shall: [6:8 encl(4)]

1. At Milestone I. Establish tentative design goals, or range of values, for energy efficiency and substitution at the system level that are responsive to projected needs of the mission area. These goals should be shown in comparison to energy efficiency and substitution capability of similar systems.

2. At Milestone II. Establish firm energy related goals when appropriate and state trade offs made between the design, operating concepts, simulators and any substitution objectives.

3. At Milestone III. Review energy consumption projections and efficiencies and their sensitivities to system populations.

DODD 4170.10 is another important document that helps to interface energy conservation into the acquisition cycle of major weapon systems. The following paragraphs of the instruction assign responsibilities for energy conservation:

1. The Under Secretary of Defense for Research and Engineering, or designee, shall: (b) Establish DOD policy to ensure that energy conservation is considered in the concept formulation, design, selection and production of weapons systems and other material. [3:3]

2. The Secretaries of the Military Departments and Directors of the Defense Agencies shall: (j) implement programs that ensure consideration of energy efficiency in the design, development, production, procurement and operation of weapons systems and production facilities. [3:4]

3. The Director of the Defense Logistics Agency shall: Encourage energy conservation practices among defense contractors in accordance with DOD Instruction 4170.9 and Defense Acquisition Regulation 1-339. [3:5]

4. The Director of the Defense Contract Audit Agency shall: develop audit programs to assess contractor achievements in energy conservation. [3:5]

The legislation and regulations previously discussed in addition to those presented in Appendix D all provide very general and at times very vague policies and procedures relating to energy conservation and systems acquisition. No regulations providing detailed specifics on how to proceed and accomplish these energy conservation goals and objectives were found during the current literature search. As stated in Appendix D, the Logistics Management Institute found that: [15:1]

> In many cases the appropriate OSD and military department directives have been or are being modified to reflect an increased management concern for the energy efficiency of weapon systems during the acquisition process.

C. SELECTED ACQUISITION CONCEPTS

There are several acquisition concepts that will be related in subsequent chapters to energy conservation and efficiency with which the reader should have some general familiarity. They include Life Cycle Costing, Energy Efficiency Standards, Design and Performance Specifications, Value Incentive Clauses and Profit Considerations. These concepts are not solely dedicated to energy conservation and efficiency. However, they can be used to enhance and promote energy conservation and efficiency given the proper management emphasis and support. [32:1-11]

1. Life Cycle Costing

Life Cycle Costing is described in the DAR as follows: [2:1-335]

> The life cycle costs of a system or item of equipment is the total cost to the Government of acquisition and ownership of that system or item of equipment over its full life. It includes the cost of development, acquisition, operation, support, and where applicable, disposal. Since the cost of operating or supporting the system or equipment over its useful life is substantial and, in many cases, greater than the acquisition cost, it is essential that such costs be considered in development and acquisition decisions in order that proper consideration can be given to those systems or equipments that will result in the lowest life cycle cost to the Government.

Life Cycle Costing (LCC) is a capital investment management technique that gives special attention to initial capital investment costs, annual operating and maintenance costs, major repairs and component replacements, complete item or system replacements, residual values and includes the time value of money. [10:I-1] It is a very useful evaluation technique that can provide a valuable input for decision-making. Depending upon the emphasis and importance that management is willing to attach to energy conservation and given that energy costs will constitute an increasingly large portion of the operating costs of many systems, the LCC approach represents significant energy conservation potential. [32:4]

2. Energy Efficiency Standards

Energy Efficiency Standards are relatively new to the acquisition process of major systems. When energy was

plentiful, any standards that were written were usually directed towards increasing the effective performance of the system. This refers to more speed, greater thrust, longer range and other system attributes that assumed the requisite energy would be supplied. EESs are simple, item by item requirements of minimal energy efficiency. [32:4] These standards could be adopted by statute and amplified by administrative regulations and management attention and would prohibit the procurement of systems with less than the prescribed energy efficiency. [11:20] Considerable analysis and thought should be devoted to the development and application of EESs. Various problems that may result in setting these Standards are: [11:20]

1. Setting the standard far too low, so that the opportunity is forfeited to acquire energy efficient items available at a slightly higher cost; the small saving in acquisition price is gobbled up by higher energy expenditures.

2. Setting the standard too high, so that it surpasses what is practicable for a particular product; the item is either unobtainable or very expensive.

3. Setting the standard so high that only one supplier can satisfy the requirement; the absence of competition either violates the purchasing statute or makes the price unnecessarily high.

Responsible EESs should consider the efficiency of systems presently in existence, the state-of-the-art and existing efficiency standards in effect in industry. The standards should be thoroughly analyzed to prevent the necessity of frequent changes. EESs as an acquisition concept or strategy also present significant energy conservation potential. [32:4]

3. Design and Performance Specifications

Design and Performance Specifications could enhance energy conservation and efficiency. The use of specifications in the acquisition process is described in DAR as follows: [2:1-1201]

> Plans, drawings, specifications of purchase descriptions for procurements shall state only the actual minimum needs of the Government and describe the supplies and services in a manner which will encourage maximum competition and eliminate, insofar as possible, any restrictive features which might limit acceptable offers to one supplier's product, or the products of a relatively few suppliers. Items to be procured shall be described by reference to the applicable specifications or by a description containing the necessary requirements.

Specifications are normally classified as either design or performance type. A design specification attempts to define the end item in terms of its physical characteristics by stating precise measurements, tolerances, materials, in process and finished product tests, quality control and inspection requirements and other information. [41:2] Performance specifications, on the other hand, are more general than design specifications and simply state various performance requirements that must be met. Performance functions such as speed and range and system characteristics such as weight and size are stated and the contractor designs his own system in compliance with the requirements. In systems acquisition, most specifications are combinations of performance and design. Each type of specification possesses energy conservation

potential and should be explored with a discussion of the advantages and disadvantages of each. [11:30]

4. Value Incentive Clauses

Another very important acquisition concept is that of Value Engineering. This concept involves the inclusion of Value Incentive Clauses (VIC) into Defense contracts in which contractors are encouraged to submit Value Engineering Change Proposals (VECP) that would help to reduce the cost of the contract. Both the Government and the contractor share in the savings that result from this program. The concept and policy of Value Engineering as they appear in the DAR are as follows:

> Concept. Value Engineering (VE) is the formal method set forth in an appropriate contract clause by which, during performance of a contract, the contractor may suggest methods for performing the contract more economically and share in any resulting savings or may be required to establish an organization aimed at identifying and submitting to the Government methods for performing the contract more economically. Value Engineering is concerned with the elimination or modification of anything that contributes to the cost of a contract item or task but is not necessary for needed performance, quality, maintainability, reliability, safety, or interchangeability; i.e., without impairing essential functions or characteristics. Value Engineering is synonymous with Value Analysis and Value Management insofar as it signifies a cost reduction method in Government contracts. The entire Value Engineering concept is aimed at finding areas of cost reduction in the contract. Specifically, VE constitutes a systematic and creative effort, not required by any other provision of the contract, directed toward analyzing each contract item or task to ensure that its essential function is provided at the lowest over-all cost. Over-all cost may include, but need not be limited to the costs of acquiring, operating, and logistically supporting an item or system. [2:1-1701.1]

> Policy. It isthe policy to provide contractors with a substantive financial incentive to undertake VE on the premise that both Government and the contractor will benefit. Accordingly, the contractor should be assured (i) that the Government will provide objective and expeditious processing of proposals submitted and (ii) that if a proposal is accepted he will receive a fair share of the savings. It is also the Government's policy to encourage subcontractor participation through extension by prime contractors of VE incentives to appropriate subcontractors. VE incentive payments do not constitute profit or fee subject to the limitations imposed by 10 U.S.C. 2306(d). [2:1-1701.2]

The Value Engineering Program provides an incentive for contractors to submit VECPs and share in the savings. Both the Government and the Contractor benefit in that the VECP may result in (1) a decrease in the cost of performance of the contract and (2) a reduction in the cost of ownership (including operating costs). [32:5] As previously stated, since energy is a main operating cost of many systems that will probably increase in the future, the use of VICs in Defense contracts could encourage manufacturers to improve the energy efficiency of their systems. [32:5]

5. Profit Considerations

The concept and Government policy concerning profit considerations are clearly presented in the DAR as follows: [2:3-808.1]

> It is the policy of the Department of Defense to utilize profit to stimulate efficient contract performance. Profit generally is the basic motive of business enterprise. The Government and defense contractors should be concerned with harnessing this motive to work for more effective and economical contract performance. Negotiation of very low profits, the use of historical averages, or the automatic application of a predetermined percentage to the total

> estimated cost of a product, does not provide the motivation to accomplish such performance. Furthermore, low average profit rates on defense contracts overall are detrimental to the public interest. Effective national defense in a free enterprise economy requires that the best industrial capabilities be attracted to defense contracts. These capabilities will be driven away from the defense market if defense contracts are characterized by low profit opportunities. Consequently, negotiations aimed merely at reducing prices by reducing profits, with no realization of the function of profit, cannot be condoned. For each contract in which profit is negotiated as a separate element of the contract price, the aim of negotiation should be to employ the profit motive so as to impel effective contract performance by which overall costs are economically controlled. To this end, the profit objective must be fitted to the circumstances of the particular acquisition, giving due weight to each of the effort, risk, facilities investment, and special factors set forth in this 3-808. This will result in a wider range of profits, in many cases, and will be significantly higher than previous norms.

A fair and equitable method for quantitatively implementing Government profit considerations is accomplished through the use of the weighted guidelines method. This profit determination method provides Government Contracting Officers with a technique that considers various profit factors used in computing and documenting their profit objectives. These weighted factors include contractor effort, contractor risk, facilities investment and other special factors such as productivity, independent development, small business participation and, in accordance with a recent revision to weighted guidelines, energy conservation. Increased emphasis on facilities investment as a part of the overall profit determination in addition to the recognition of energy conservation improvements

made by contractors as special profit factors will hopefully incentivize and motivate contractors to invest in energy efficient facilities, production processes and hardware. The use of the profit motive of industry possesses significant energy conservation potential for the future.

All of the acquisition concepts discussed thus far are well established and well known within the Defense acquisition community. None of these concepts are now or should be totally dedicated to enhancing energy conservation. However, all of these concepts could be used in the future to emphasize and initiate increased visibility on the problems of energy conservation and efficiency in major weapon systems acquisitions. [32:1-11]

IV. ENERGY CONSERVATION ACQUISITION STRATEGIES

The term "Energy Conservation Acquisition Strategies" (ECAS) does not represent anything new or innovative to the Defense acquisition arena. It is a phrase that was developed by the researcher to describe existing acquisition strategies that could possibly be used as vehicles to incentivize, motivate or require Defense Contractors to concentrate their efforts on energy conservation and efficiency. The ECASs described in this Chapter are not the only strategies that could be used to enhance energy conservation and efficiency. New and innovative strategies will undoubtedly be developed in the future. However, this

research concentrates on Life Cycle Costing (LCC), Energy Efficiency Standards (EES), Design and Performance Specifications, Value Incentive Clauses (VIC), and Profit as existing strategies or techniques that could be used as ECASs in weapon system acquisitions.

This Chapter will discuss the views of the Defense Aerospace Industry (hereafter referred to as Industry) relating to the ECASs cited in the responses to the researcher's Energy Questionnaire, Appendix A. It should be noted that approximately 76 percent of the respondents had annual sales in excess of $100 million with 19 percent between $10 million and $100 million and five percent under $10 million. Of these sales statistics, 71 percent of the respondents stated that the percentage of sales related to defense was greater than 75 percent of their total business. The Navy and the Air Force were the DOD agencies with which the respondents (approximately 86 percent) conducted the bulk of their defense business. These statistics should be kept in mind when reviewing the forthcoming ECAS discussion.

A. LIFE CYCLE COSTING (LCC)

The concept of LCC, as previously discussed, is an evaluation and decision-making technique that addresses the total acquisition and ownership costs to the Government of a particular system over its full life. It is an existing strategy that could possibly be used as a vehicle

to enhance energy conservation and efficiency in weapon system acquisitions. [32:4] Emphasis could be placed on the energy costs of the weapon system(s) being evaluated and this cost could be used as a principal factor in decision-making processes such as source selection. The emphasis on a weapon system's energy costs will undoubtedly become more important and pronounced as energy becomes more scarce. This degree of emphasis will naturally depend upon the type of weapon system being procured, the amount of energy it will consume over its useful life and the percentage of total LCC that the cost of energy represents. These factors will also influence the effectiveness that LCC will have as an ECAS in the future.

It appears that energy is being considered in the LCC calculations of most of the respondents. Approximately 13 contractors (62 percent) stated that they were including the cost of energy as a factor in LCC. Of this 13, nine contractors (69 percent) stated that they had specifically assigned an individual or group of individuals the responsibility of calculating and analyzing the energy cost of the hardware over its useful life. Considering the energy problems that the United States has been facing now for seven years, the researcher did not find these figures to be very extensive regarding LCC utilization and participation.

Regarding Industry's perception of the effectiveness of LCC as an ECAS to analyze and hopefully reduce the operational

energy consumption of weapon system hardware, 69 percent stated that they agreed, 23 percent were neutral and the remainder disagreed. These figures are consistent with the utilization of LCC by the respondents and as previously stated are assumed related to the type of hardware being manufactured and its associated energy intensity. A good example would be aircraft engines versus aircraft avionics.

Various advantages and disadvantages were cited for the use of LCC as an ECAS relating to the acquisition of weapon system hardware. The advantages cited were numerous with many being standard characteristics of LCC such as:

1. Energy in LCC helps to analyze long term cost considerations.

2. The cost of energy represents a significant ownership cost and should be included in LCC.

3. LCC is important in that it considers all costs (i.e., acquisition, operating, maintenance, disposal) and should include and emphasize energy costs.

4. LCC will help to reduce the energy usage of the weapon system by highlighting and emphasizing the cost of energy.

Other advantages presented were as follows:

1. LCC will improve the energy efficiency of the weapon system and will help to promote energy efficient technology.

2. LCC is important in that it gets energy costs considered at all. It highlights a need and is the first step towards positive action.

3. LCC is important because fuel costs are calculated, isolated and visable.

4. Energy in LCC is important because it forces estimators to consider the cost and availability of energy, as well as, energy alternatives and their respective costs.

5. Emphasizing energy in LCC analysis could aid the Government in proposal evaluation.

These advantages make the use of LCC as an ECAS appear to be a prudent business decision, however, the disadvantages must also be considered. The disadvantages presented by Industry were as follows:

1. The cost of energy represents only a small portion of the total LCC equation in most cases and over-emphasis of this cost element may adversely affect critical weapon system effectiveness and detract from other performance characteristics of the system.

2. Emphasis on energy costs as a part of LCC should not be a consideration in the acquisition of weapon systems for the defense of the United States. It would place an additional burden on an already overburdened procurement system.

3. There is no accurate method of determinating, analyzing and presenting any form of LCC (including energy costs) on weapon systems whose characteristics and capabilities are not yet known or fully developed. There is a lack of accurate future estimators and those that do exist are very subjective.

4. The small savings accrued by emphasizing energy costs in the LCC equation would be offset and overshadowed by the high costs necessary to develop and implement the administrative systems.

5. Different weapon systems have differing degrees of energy intensity. Energy costs in the LCC equation should only be emphasized on those systems with high energy intensity and not blatantly imposed on all systems across the board.

6. LCC is not designed for the purpose of highlighting energy costs and availability and could not be relied upon to serve such purposes. It will not improve, assist or benefit evaluation of energy alternatives and could possibly hamper the evaluation of alternatives if the cost of energy is overemphasized.

Of the four contractors interviewed, no other comments regarding LCC as an ECAS were discussed other than the

advantages and disadvantages already cited. Two of the contractors interviewed agreed that LCC could be an effective ECAS and two were neutral on the subject. The main point that was raised repeatedly was that the effectiveness of LCC as an ECAS depended upon the energy intensity of the system being manufactured. The researcher left the interviews with the distinct impression that the reason for the lack of enthusiasm and utilization of LCC as an ECAS was the lack of emphasis by DOD on weapon system's energy costs to date.

All of the advantages and disadvantages presented by Industry appear to have merit, however, some deserve analysis and discussion. The researcher is in agreement with all of the advantages presented, but takes exception to some of the stated disadvantages. The cost of energy will continue to increase in importance as energy becomes more scarce and, as such, should be included in LCC calculations. The problems with the accuracy of these calculations and projections is recognized, but this does not negate the need. By emphasizing energy efficiency in weapon system design there will undoubtedly have to be tradeoff considerations in performance. These tradeoffs would probably not be necessary if energy was in surplus. However, slightly decreasing performance to increase energy efficiency in an energy-scarce environment makes considerable sense and could mean the difference between

mission success and failure. The use and emphasis of LCC as an ECAS must be applied logically and intelligently. It should be applied to energy-intense weapon system hardware so as to increase the return on investment. The use of such a policy on inappropriate systems could result in the administrative implementation costs far out weighing the energy savings. The researcher finds the statement that LCC is not designed to highlight energy costs to be invalid. An LCC spread sheet can be used to highlight whatever costs the evaluator deems appropriate. As long as the energy cost data is available it can and should be assigned a relative priority compared to other cost factors and evaluated accordingly.

Based upon the results of the Energy Questionnaire, the majority of respondents feel that LCC would be an effective ECAS in weapon system acquisition. This researcher concurs with this finding subject to the points previously discussed. The General Accounting Office (GAO) has cited LCC as a potential ECAS in a recent GAO report by emphasizing the following: [32:4]

> Life cycle costing considers operating, maintenance and other costs of ownership, as well as, acquisition price. Because energy expenditures constitute an increasingly large portion of the operating costs of many items, life cycle costing represents significant energy conservation potential.

This concept has also been discussed in Ivan J. Tether's book, Government Procurement and Operations, primarily from the standpoint of the Government's acquisition of buildings

and commercially oriented products such as air conditioners, refrigerators, etc., normally procured by the General Services Administration. It is also very interesting to note that as previously discussed, 86 percent of the questionnaire respondents conducted the bulk of their defense business with the Air Force and the Navy, yet only 62 percent were including energy in their LCC calculations. This poor use of LCC regarding energy costs by contractors associated specifically with the Navy is rather ironic considering the information contained in OPNAVINST 4100.5A regarding an energy effectiveness review: [9:4]

> All Navy systems in the program initiation, demonstration and validation, full-scale engineering development, and production and deployment phases will be subject to this review. The objective is to integrate energy consumption data as an element of operating and support cost in the Life Cycle Cost and Design to Cost goals. These energy effectiveness reviews will include major systems, components and subsystems within the acquisition process. (Emphasis added)

Therefore, it does appear that instructions do exist and are being developed to emphasize energy as a part of the total LCC calculation. The poor utilization and emphasis of energy as a part of LCC by Defense Contractors (as described in this section) appears to stem from the lack of specific implementing instructions within DOD, as well as, the lack of DOD upper management support of this very critical issue. Both of these issues were discussed in Chapter III.

B. ENERGY EFFICIENCY STANDARDS

Energy Efficiency Standards (EES) are simple item by item requirements of minimal energy efficiency as previously discussed. The use of these standards as an effective ECAS was also cited in a recent GAO report. [32:4] The progress made to date regarding EESs pertains mainly to energy consuming products acquired by GSA. GAO cited the following: [32:7]

> Progress in applying quantitative energy efficiency standards is mixed. GSA has implemented a program to ensure that all passenger automobiles acquired by Federal executive agencies meet certain average fuel economy standards. The use of energy efficiency standards for other energy consuming products (refrigerators, freezers, dishwashers, clothes washers and dryers, water heaters, kitchen ranges and ovens, etc.) however, has been hampered because DOE and the National Bureau of Standards have been slow in developing those standards, which are being developed for nationwide use.

The use of EESs by DOD in the acquisition of major weapon systems, components and subsystems is an altogether different issue of greater complexity. It is an issue, however, that deserves some consideration and discussion. This researcher found that DOD's use of EESs was minimal at best and that this was due primarily to the difficulties and complexities of developing and applying item by item requirements of minimal energy efficiency. This should not be construed as an indication that DOD is not doing research in the areas of energy conservation and efficiency for its weapon system hardware. Extensive research and development (R&D) programs are being conducted within all

of the Services to increase energy efficiency and decrease energy consumption. The Department of the Navy's Energy Program and Plan is a prime example. [7:54] Extensive programs are currently in affect to scrutinize Navy energy distribution and allocation, Navy shore operations, aircraft operations and ship operations. Various R&D programs to develop efficient configuration/component modifications for naval ships and aircraft and the implementation of more efficient operational procedures are being undertaken. Thus, by virtue of this research, DOD is beginning to review the possibility of having EESs for weapon system hardware. This stage of development of EESs must be considered when reviewing the following discussion of Industry's perception of this potential ECAS.

At present it appears that Industry is somewhat divided regarding the effectiveness of EESs as an ECAS for weapon system hardware. Approximately 38 percent of the respondents were undecided or neutral on the subject, 29 percent agreed and 29 percent disagreed. This researcher feels that this uncertainty and polarization can be attributed to the lack of exposure that Industry has had with EESs. This is supported by the following data which indicated that of the 21 respondents, 15 (71 percent) stated that DOD had not applied any EESs to the systems that they are now designing or manufacturing. Three stated that EESs, in some form, had been applied to their systems and three respondents did not complete the question. With regard to subcontractors, 76 percent of the respondents stated that they did

not impose EESs on their subcontractors and 12 percent stated that they did. The remaining 12 percent did not complete the question. Because of the early stage of development of EESs, it is hard to assess its potential effectiveness. Industry has not been exposed to EESs to any great extent mainly because of the problems encountered by DOD in actually developing and implementing the efficiency standards. A discussion of Industry's stated advantages and disadvantages is therefore appropriate.

The primary advantages cited by the respondents were as follows:

1. EESs will motivate energy conservation, reduce overall costs and encourage the study of low energy consumption components.

2. The use of EESs will provide dollar and energy efficiency and will establish immediate savings upon the use of the hardware.

3. EESs can be used to ensure and enforce minimal energy consumption and will make manufacturers more cognizant of energy conservation. It will also help to generate other ECAS ideas.

4. These standards can serve as long range goals for R&D projects to conserve energy and if specified correctly would be a good criteria to evaluate under a design review.

5. EESs are important in that they get energy considered at all and they would provide for an excellent management control tool.

6. Standards would definitely improve and reduce energy consumption. Increased energy efficiency would increase the amount of weight, volume, etc. available for payload.

7. EESs will create an energy conscious atmosphere in striving to meet the standards. This will result in higher reliability of equipment with lower cooling and operating costs. It could fit in with a company's cost reduction program and might encourage further miniaturization of electronic equipment to reduce weight, size and power.

These advantages, which to the researcher all seem reasonable, have to be compared with the stated disadvantages. These are as follows:

1. EESs should not be a consideration in weapon system acquisition. Other factors such as performance and supportability are much more important. EESs would upset the priorities associated with the weapon system's intended use.

2. Many exceptions would be taken by Industry to EESs. The results of EESs would be difficult to compare among competitors, the objectiveness of these measurements would be questionable and fewer companies would bid, thus reducing competition and increasing costs.

3. EESs would become obsolete quickly and would stagnate improved energy efficiency. They would result in an increase in Government regulations and a proliferation of bureaucracy. Creativity with regard to weapon system effectiveness which may require more energy than the standard permits would be limited. EESs would become another control on private industry that restricts R&D in other fields that may be even more productive.

4. The development and application of EESs could be redundant if contractors are already addressing energy goals in reliability and maintainability programs. High manpower implementation costs would be incurred by both Government and Industry. The development of EESs would require considerable data collection, analysis, money, time and paperwork.

5. The attempted application of EESs by DOD could bog down in contract negotiations concerning what tradeoffs in other areas such as performance DOD is willing to accept. The required production processes necessary to manufacture energy efficient hardware might consume more energy than would be saved in the operation of the hardware.

6. Industry is too diverse for the intelligent application of EESs. Weapon system hardware is too complex and sophisticated for EESs to be appropriate. Defense adequacy must be the overriding figure of merit. More complex and image serving requirements are counterproductive to getting substance for the defense dollar.

All of the four contractors interviewed stated that they were neutral regarding the effectiveness of EESs as an ECAS.

Three of the four contractors stated that DOD has not imposed any EESs on their systems and that they did not impose EESs upon their subcontractors. The one contractor who did cite the use of EESs stated that they were imposed via power allocations meaning that the hardware being produced was dependent upon a limited power source and that the hardware could only use a specific amount of the power available. This is a method of limiting energy consumption but doubt remains as to whether the amount of power allocated is energy efficient or inefficient. The neutrality of the four respondents interviewed, as well as, the remainder of the respondents appears to be caused by the lack of exposure Industry has had to EESs.

It should be noted that discussions on the application of EESs to weapon system hardware in the current literature is very limited. GAO has stated that EESs as an ECAS do possess energy conservation potential as previously discussed. [32:4] The pros and cons of using EESs as a purchasing strategy for energy consuming products such as refrigerators, air conditioners, etc., has also been addressed in the current literature. [11:1] However, EESs and weapon system hardware is an entirely different situation. The advantages and disadvantages cited by Industry all appear valid to this researcher with the disadvantages carrying slightly more weight. This position is taken because EESs appear to be a reasonable ECAS to force industry to address energy conservation and efficiency for weapon systems,

however incentives rather than regulations seem to be more appropriate at this time. Depending upon the success of these incentives and Industry's response thereto, EESs could be developed as a final measure. However, as the search for energy conservation incentives goes on, the problems of developing, implementing and enforcing EESs will have to be addressed and hopefully resolved in the interim.

C. DESIGN AND PERFORMANCE SPECIFICATIONS

Design and performance specifications have significant differences. A design specification, as previously discussed, attempts to define the end item in terms of its physical characteristics by stating precise measurements, tolerances, materials, in-process and finished product tests, quality control and inspection requirements and other detailed information. [41:2] This type of specification may vary in size and complexity depending upon the nature of the hardware. With regard to responsibility and risk, the Government accepts general responsiblity for errors, omissions or deficiencies in the specifications or drawings. There is little risk to the contractor if the contracted item is deficient or inadequate as long as it has been manufactured in strict compliance with the specification. [41:5] Therefore, a design specification calls for the fabrication, assembly and testing of an item in strict compliance with a specific detailed description which will

result in an identical or interchangeable finished product according to the original requirement or plan. [41:3]

Performance specifications, on the other hand, are more general than design specifications. These specifications are normally for R&D projects involving state-of-the-art hardware. The contractor has greater responsibility and risk under a performance specification vis-a-vis a design specification. Flexibility is also increased in that the contractor is basically free to design his own system as long as it complies with stated criteria such as speed, range, weight, size, mean time between failures and other descriptions of function or performance.

Industry's perception of the effectiveness of design versus performance specifications as ECASs turned out to be exactly opposite from what the researcher was expecting. Most respondents indicated that design specifications would be a more effective ECAS than performance specifications. Approximately 48 percent of the respondents indicated that design specifications would be an effective ECAS, whereas only 38 percent felt that performance specifications would be effective. In both cases, 24 percent of the respondents were neutral and the remaining disagreed.

Various advantages and disadvantages were presented for the use of design specifications to enhance energy conservation and efficiency. These were as follows:

1. Design specifications would define goals. Contractors are familiar with working with specifications such that the inclusion of energy considerations into the specification would assure the analysis of energy consumption.

2. The use of design specifications would make energy reduction a design objective and would initiate effort early when it is most effective. Energy conservation and efficiency would be made mandatory and would have to be monitored.

3. Design specifications provide specific guidelines and could increase the reliability of the equipment. These specifications could be developed to reflect a realistic minimum energy usage.

4. Design specifications ensure that programs are tailored to end item application. They can be planning guides that serve as long range goals and objectives for future R&D projects.

5. Design specifications could spur the development of low power components and could permit intelligent tradeoffs between cost and performance. They could result in decreased LCC of the hardware and a reduction in national energy usage.

6. Design specifications, if consistently invoked, could become a way of life during the design stage. Tradeoffs between energy consumption and military performance requirements would be carefully considered.

As is the case with other ECASs that have been discussed thus far, the advantages must be weighed against the disadvantages. The disadvantages cited by the Defense Aerospace Industry were as follows:

1. The consideration of energy efficiency in design specifications would require very high administrative manpower costs to implement. The Government's costs of maintaining and updating the specifications would also be increased. There are too many procedures and diversions now to acquiring effective weapon systems.

2. Design specifications are too constraining and inhibit innovation in design. Design flexibility is drastically reduced and there would be a very negative reaction from design engineers.

3. Design specifications for energy efficiency would result in increased acquisition and development costs. Government procuring agencies are not willing to spend money up front for future savings.

4. Possible conflicts between energy efficient design versus military requirements could result from the use of design specifications. Increased performance such as speed or acceleration may require increased energy consumption for the success of the mission.

5. The use of detailed design specifications for energy efficiency could require production processes that use more energy than the hardware saves.

6. Reduced energy consumption or increased energy efficiency are not the only factors to be considered in weapon system design. Energy conservation and efficiency, although important issues, should not be factors in the acquisition of weapon systems for the defense of the United States.

Design specifications are detailed descriptions of how an item must be built so that the finished product is interchangeable or standardized in accordance with a basic plan or drawing. The rigidity and lack of flexibility of design specifications is similar to that of EESs. This rigidity tends to decrease the responsibility and risk of the contractor regarding unacceptable hardware as long as the contractor has strictly complied with the specification. This may possibly be a reason for Industry's indicated preference of design versus performance specifications relating to energy efficiency. It may be that if energy efficient hardware is desired by the Government and this requirement is to be included in the specifications, then Industry would prefer that the Government assume responsiblity and risk for the final outcome.

Regarding performance specifications, the following advantages were cited, some of which are very familiar to the advantages of design specifications:

1. Specifications define goals and programs are tailored to end item applications. Contractors are familiar with working with specifications.

2. Performance specifications would result in a reduction in national energy usage and would encourage innovation and imagination.

3. Performance specifications allow the contractor maximum flexibility. They provide greater latitude in making tradeoffs.

4. Requires contractor to guarantee proper performance in addition to energy efficiency.

5. Broadens alternatives available regarding performance functions and cost reduction. Each cost is directly or indirectly energy related.

A greater emphasis on performance specifications, rather than design, has been cited by GAO and the current literature, as offering more potential for improving energy efficiency. [32:4] The disadvantages cited by Industry for Performance Specifications include:

1. Loss of specific energy efficiency parameters.

2. Could result in nonstandardized equipment.

3. Contractors given too much flexibility and latitude. Will result in frequent and unnecessary changes that could impair effectiveness of the system.

4. Vague and general requirements often conflict and cannot be met in total.

Of the four respondents interviewed, the principal comment was that in reality there is no such thing as either a design or performance specification. In theory, the two can be separated but realistically attributes of both types

usually appear in most specifications. It is interesting note that of the 21 total respondents, ten (47 percent) felt that both design and performance specifications would be effective ECASs. This could be viewed as supportive of the assumption that most specifications are combinations of both design and performance types.

If the assumption is made that design and performance specifications are separate and distinct, then the researcher is of the opinion that the design type would be the most effective ECAS. This is due primarily to the issues of standardization and interoperability. It would be of no benefit to enhance energy efficiency via DOD specifications if it results in the manufacture of nonstandardized hardware. This position is opposite to that of GAO as previously discussed. However, if standardization was not an issue, a performance specification, with its increased contractor flexibility, imagination and innovation would probably result in accelerated development of energy efficient weapon system hardware.

If the assumption is made that realistically all specifications have attributes of both design and performance types, then the researcher is of the opinion that it is inevitable that energy efficiency considerations will be strongly emphasized in specifications in the future. During the early stages of the weapon system's development, the specifications will be general in nature and will probably resemble performance type specifications. As the system

proceeds into production and the baseline stabilizes, the specifications will probably begin to resemble design type specifications. The main observation to be made is that energy efficiency considerations will inevitably receive greater emphasis in DOD specifications in the future and that specifications in general have the potential of being an effective ECAS.

D. VALUE INCENTIVE CLAUSES

The value engineering (VE) program in DOD was established in 1963 and has also been referred to as value analysis, value control, value improvement or value management. The concept is as follows: [31:1]

> Value engineering involves a systematic analysis of each function to be performed by an item with the objective of achieving the function at the lowest overall cost consistent with performance, reliability, quality and maintainability requirements. In essence, the prevailing viewpoint of value engineering analysis is that while anything providing less than the functional capability is unacceptable, anything providing more is unnecessary and wasteful and should be eliminated or modified. Those features or characteristics of an item which exceed actual needs and contribute nothing to essential functional capability are often called "gold plating."

DOD's VE program consists of an in-house effort conducted by Defense personnel and a contractor effort that encourages the submission of value engineering change proposals (VECP). The program is implemented through the use of two types of value incentive clauses (VIC) included in contracts; namely an incentive clause and a program requirement clause.

> The VE incentive clause is intended to encourage the contractor to voluntarily develop and submit VE change proposals and rewards it with a share of the savings resulting from each proposal that is accepted. This clause is used principally on production contracts. The VE program requirement clause obligates the contractor to conduct a sustained VE effort at a prescribed level. This effort is directly reimbursed as a contract line item and the contractor also shares in the savings resulting from each accepted proposal. The contractor's sharing rate under this arrangement is considerably less than under the incentive clause. The program requirement clause is designed primarily for contracts covering conceptual validation and full-scale development phases of a program. [31:2]

The use of VICs as an effective ECAS has been cited by GAO in the same report mentioned for LCC, EES and design and performance specifications. The following statement was made: [32:5]

> The value incentive clause encourages contractors, during the life of the contract, to submit value change proposals. . . Since energy is a main operating cost of many items, the value incentive clause could encourage manufacturers to improve the efficiency of their commodities.

Similar statements have also been made in the current literature. [11:30] GAO, in another report addressing impediments to reducing the costs of weapon systems, re-emphasized the use of VICs as follows: [35:35]

> We believe value engineering is an effective management tool for identifying and eliminating unnecessary costs in hardware procurement and construction work. In our opinion, it can also be effective in reducing not only the procurement cost for services and software, but also the costs of the internal operations of an organization and the service it renders.

Although GAO and others have agreed that DOD's VE program is worthwhile and could be used as an effective

ECAS it is not without its problems. In yet another report GAO cited that the main problem facing the VE program is a pronounced lack of top management support throughout DOD. [31:12] This lack of support has been identified as more pronounced in the Air Force and Navy with the Navy's program being the least productive. In a report prepared by the Office of the Assistant Secretary of Defense, Installations and Logistics in 1975 on the Navy's VE program, the following reasons for poor performance were identified: [31:12]

1. No management support for the VE program except in Naval Air Systems Command.
2. No Navy effort to provide funding for the program.
3. Sharp reductions in the number of Navy VE personnel assigned to support the program.
4. No training for Navy personnel in the use and administration of VE contract clauses since 1970.

Therefore, the effectiveness of VICs as an ECAS, in addition to the future viability of the VE program in general, seems to depend considerably on the support it receives from top management within DOD.

From the results of the Energy Questionnaire, VICs are being used in Industry. Approximately 67 percent of the respondents stated that they did have VICs in their current defense contracts. Only 19 percent stated that they did not and 14 percent did not address the question. However, the use of VICs and the submission of VECPs relating to energy conservation was practically nonexistent. Approximately 81 percent of the respondents stated that they had never

formulated and submitted a VECP related to energy conservation and efficiency. Although this poor utilization is rather discouraging in an energy-scarce environment, it should be noted that 48 percent of the respondents did agree that VICs could be used an an effective ECAS. Only 24 percent disagreed and 23 percent were neutral or undecided on the subject.

The following advantages for the use of VICs as an effective ECAS were presented by Industry:

1. Efforts to search for energy conservation methods and ideas can be concentrated into specialized groups.

2. VICs will keep the objective of energy conservation in the forefront. They will encourage the search for low energy and low cost approaches.

3. Presents another viable method of implementing action by Industry to reduce energy consumption. It will result in savings to the Government and the U.S. economy is terms of dollars and energy.

4. The dollar incentive of Industry is the strongest motivation. Industry's share of the VE savings will encourage the search for ideas relating to energy conservation and efficiency.

5. The objective of the VE program of achieving lowest overall costs consistent with performance, quality, reliability and maintainability requirements will enhance the analysis of tradeoffs of energy consumption versus military requirements.

6. Savings in the hardware's energy use almost always result in larger savings in processing the equipment.

The following disadvantages were presented:

1. The use of VICs could require significant and complex changes to the statement of work and the basic contract.

2. The contractor cannot claim all savings and must share with the Government. The determination of savings is too subjective and is hard to measure and weigh.

3. VICs should be used to get the maximum value for the defense dollar and not for special projects such as energy conservation.

4. The VE program is not supported by the procuring activities and is not administered effectively. It is too slow, too subjective and has been made too complicated by Government.

5. Emphasis on energy conservation via VICs could result in reduced function and performance due to decreased power which is not consistent with the objective of the VE program. It could affect critical weapon effectiveness.

6. May dilute effort to make savings in other areas and would tend to bias awards to contractors with Government facilities.

Of the four respondents interviewed, two agreed, one disagreed and one was neutral regarding the effectiveness of VICs as an ECAS. All stated that they had VICs in their defense contracts, however none had ever submitted a VECP relating to energy conservation or efficiency. One respondent stated that although no VECP had ever been submitted specifically on the energy issue that several had been submitted relating to increased reliability and maintainability that indirectly resulted in reduced energy consumption. The lack of top management support by DOD personnel was perceived to be a big problem, as well as, the difficulty in determining and measuring savings resulting from VECPs. The researcher was left with the impression that the poor Industry support of the VE program was due to the poor support and administration of the program within the Government.

The advantages and disadvantages cited for VICs as an effective ECAS all have merit. However, the majority opinion of Industry does seem to indicate that the advantages

slightly outweigh the disadvantages and that VICs could be an effective ECAS if the Government would only support, manage and administer the program properly. It would appear that as the energy issue grows in importance, that some contractors who have been submitting VECPs specifically relating to reliability and maintainability (with indirect energy conservation side effects) could possibly benefit by submitting these VECPs directly relating to the issues of energy conservation and efficiency. This could result in a higher probability of acceptance by the procuring activity. Depending upon the future success of DOD's VE program, the use of VICs does appear to have potential as an effective ECAS.

E. PROFIT CONSIDERATIONS

It is DOD's policy to utilize and harness the profit motive of Industry in order to incentivize and motivate Defense contractors towards efficient contract performance. The United States Government and specifically DOD, has done much over the years to promote the public interest and enhance the national defense by attempting to learn more about the concept of profit and by applying this knowledge wisely in the course of Government procurement. Although the general policy of utilizing the profit motive of Industry to stimulate efficient performance has remained intact, the computation and determination of profit has changed considerably over the past 40 years. It has evolved from a very

subjective method based entirely on precedence to a new, fair and equitable method that involves the use of the Weighted Guidelines (WGL) technique. [16:2]

The WGL technique was developed in 1964 and has been refined and modified over the years. A major profit study entitled "Profit 76" was initiated in May 1975 that revised the factors used in determining profit, the weight mix and weight ranges applied to these factors and also made the use of these profit guidelines mandatory when negotiating certain contracts. Since "Profit 76," GAO and the Logistics Management Institute (LMI), have issued reports recommending changes to DOD's profit policy and the WGL technique. As a result of these studies and on the basis of its own in-house study, DOD recently revised the basic WGL technique again in order to (1) increase emphasis on facilities capital investments; (2) place less emphasis on profit based upon cost; (3) establish specific criteria for determining profit allowances for facilities investments, cost risk and productivity improvements and; (4) initiate separate WGLs for manufacturing, service and R&D contracts. [16:12]

The new profit policy is summarized by DOD as follows: [16:12]

1. The profit policy is based more on the contractor's return on investment in facilities which should benefit the Government by lowering the cost on end items delivered.

2. The policy is aimed at correcting "Profit 76" discrepancies pointed out by the GAO and OSD studies.

3. The policy will prevent growth in total profit dollars versus the restructuring of profit dollars

based upon investment by realistically evaluating (a) the contractor effort to be performed; (b) the cost risk involved and; (c) the risk of facilities investment.

4. The major thrust of DOD profit policy is to lower the overall unit cost of end items through investment. Contractors must realize that for the added dollars for investment, the benefits of lower unit costs must be given to the Government.

As previously discussed, the weighted factors in the WGL technique include contractor effort, contractor risk, facilities investment and special factors. By the aforementioned recent revision, energy conservation is now considered as a special factor. This combined with increased emphasis on facilities investment could make the use of profit an effective ECAS for the future. The inclusion of energy conservation and efficiency as part of the profit objective is at least an indication that the problem has been recognized. This recognition, however, is only the first step and the success and effectiveness of profit as an ECAS will depend upon the degree of top management support allotted this critical issue within DOD.

The results of the researcher's Energy Questionnaire indicate that Industry agrees that profit can be used as an incentive for the Defense Industry to conserve energy related to the acquisition of weapon system hardware and the production processes associated therewith. A total of approximately 52 percent agreed with this statement, 14 percent were neutral and 28 percent disagreed. Industry was less enthusiastic regarding the increased emphasis on

facilities investment for motivating contractor investment. Only 43 percent felt that the increase would be beneficial, 14 percent were neutral and 33 percent felt that it would be insufficient. The following comments were presented:

1. The increased emphasis in the Weighted Guidelines Policy is relative only, not absolute. The increased emphasis is elsewhere offset by lowering other factors such that in the aggregate the contractor receives the same (not more) profit anyway. Therefore, while the increased emphasis looks good on a briefing chart, it does not serve to effectively increase real profit and is therefore canceled out as a practical consideration.

2. A possible profit incentive based upon a meaningful measurement such as total energy used versus production input might be more beneficial than increasing the WGL facilities investment factor.

3. No increase in the facilities investment factor will do any good as long as total profit is reduced by the WGL technique as it is now. A 25 to 50 percent incentive might be beneficial if contractors were able to keep the incentive.

4. Improper and inept Government administration mitigates against an effective facilities investment policy. Regardless of the factor employed, Industry's experience has shown that most Government Contracting Officers don't follow the WGL during contract negotiations anyway.

5. An increase in Industry's facilities investments for energy conservation and efficiency would require a separate factor as an incentive such as those for contractor effort, risk and facilities.

With regard to possible alternatives to the increased emphasis on facilities investment the following comments were presented:

1. If the total net profit level is increased then there would be motivation. However, to slice up a relatively low profit into various components without any overall increase is a waste of time.

2. Ensure that the increase in energy efficient facilities investments in fact will yield a material and recognizable improvement in profit (after taxes) and that such increase in not correspondingly taken away elsewhere in the overall operation and application of the Weighted Guidelines.

3. Some improvements in facilities investments will happen by just economics and competition. By virtue of selfmotivation, as energy costs increase contractors will respond in order to remain competitive.

4. Pricing structures for most public utilities inhibits any significant expectations for cost savings in facilities investments. Until cost effective, alternative energy sources are developed, facilities investments for reasons of energy conservation will be minimal.

5. Other alternatives include a 50 percent investment tax credit, an increase in furnishing Government owned facilities, shorter asset lives commensurate with rapidly changing technology, tax exemptions and specific dollar incentives for energy efficient facilities.

The -5 to +5 percent factor for energy conservation as a special factor on the WGL provides an incentive to contractors to develop innovative ideas for conserving energy. Industry's response to this statement was that 33 percent of the respondents agreed, 24 percent were neutral and 33 percent disagreed. The following comments were presented:

1. Strongly disagree! At present the $\pm$ 5 percent factor is an adjustment applied to the otherwise derived amount of WGL profit or fee. It is, therefore, a minor adjustment at best. Moreover, many other factors conceptually contribute to this adjustment factor. For example, our company has consistently received the highest rankings for our Small Business and Minority Business programs with recommendations from our AFPRO for maximum consideration (i.e., +5%) already. Therefore, the multitude of inputs for this factor creates an overlap and duplication effect which completely obscures even the theoretical impact of energy conservation as an effective factor for innovative ideas. This should not be construed to say that innovative ideas are not implemented for many other reasons, however.

2. Special individual factors are not considered as motivating.

3. At least double the factor would be required if not more. Innovative development is expensive!

4. Better than nothing, but insufficient!

5. Rising costs and competitive market place already provide incentive.

6. No factor would be effective. Negotiators generally look at total profit rather than the details. The factor would have to be paid by an agency outside DOD.

The information presented thus far on profit indicates that Industry's perception is that although profit is a viable motivator and incentive, DOD's policy keeps profits relatively low and at the same time optimistically attempts to support and successfully resolve a myriad of important national issues (i.e., energy conservation). Put in simpler terms, the DOD profit pie is relatively small and can only be sliced a finite number of times if each slice is going to mean something to somebody. To adequately address, support and make progress on the ever-increasing number of national issues included in DOD's profit policy will, in the long term, inevitably require a significant increase in total profit dollars.

When asked if the use of profit to motivate Industry to conserve energy would be an effective ECAS that should be emphasized more in the future, 48 percent agreed, 19 percent were neutral and 24 percent disagreed. The following alternatives to the use of profit to conserve energy were presented:

1. Accelerated depreciation.

2. More energy related investment tax credits for energy efficient equipment and facilities.

3. More money through the use of VICs or special fees that the contractor would realize effectively.

4. Relaxation of some regulatory restrictions.

5. Specific measurable dollar incentives for energy efficiency or cost disallowances for energy inefficiency.

One respondent who agreed that profit could be used to motivate energy conservation put forth the following qualifications:

> Profit can be a most effective way to motivate industry if it is also understood that what is being discussed represents real (after tax) net profit augmentation. Since realized (after tax) contractor profit typically("Profit 76" Study) is only about one-third of contractually negotiated amounts, and since many contractural accommodations are made simultaneously with the final profit development on each individual contract, then the face value of profit is a highly tenuous indicator of real motivating impact.

The following advantages were presented regarding the use of profit as an effective ECAS related to the acquisition of weapon system hardware:

1. Profit is the strongest driver to Industry. Top management's interests and responses are in profits. It will aid in management's visability and impetus towards energy conservation and efficiency goals.

2. It will increase Industry's awareness and provide a below the line incentive. If large enough, there is no question that Industry will respond.

3. Profit is a universal concept. It will encourage energy conservation and efficiency and the construction of energy efficient facilities. Companies who attain goals will be rewarded.

4. It will help to achieve mutually beneficial goals, as well as, important national goals. For example, productivity might increase with more energy efficient equipment and facilities.

5. It may (or may not) decrease overall weapon system's cost to DOD.

The disadvantages presented were as follows:

1. Too many games are already being played with profit. Many variables determine a contractor's actions and they differ among contractors.

2. Profits are limited on Defense contracts. Below the line incentives are seldom realized as they are supposed to be and computations tend to be a mere formality. Corporate profits are taxed 50 cents on the dollar. Until profit ceilings are lifted, the whole matter is academic and not pertinent.

3. If details of profit incentives are couched in overly complicated Government terminology, and paperwork, Industry may not be responsive.

4. Energy savings are difficult to measure. Profits are measured in dollars, not BTUs. Confuses profit objectives. Confuses profits with cost control. May increase overall weapons cost to DOD.

5. Use of profit for energy conservation (i.e., increase in total profit dollars) may exceed and outweigh proportion of energy savings.

6. May be mere window dressing. May over or under estimate real improvements. May impinge on other more important contractual aspects.

Of the four contractors interviewed, no other significant information was presented regarding profit other than the information already discussed. All of the data presented herein regarding facilities investment, special factors and the advantages and disadvantages of profit is self-explanatory and needs no clarification. The researcher's observation is that profit has the potential of being an effective ECAS, but its long term success is linked to the basic core of DOD's profit policy. If this policy is to prevent growth in total profit dollars by "realistically"

evaluating contractor effort, risk and facilities investment and at the same time increasing the number of important national issues being supported by profit (i.e., energy), then as stated by one respondent "the whole matter is academic and not pertinent." It simply will not be successful. There are several very critical issues facing the United States today, productivity and energy conservation being two of them, that will require significant capital investment in the future. As these issues increase in number and importance, a DOD profit policy aimed at preventing growth in total profit dollars appears to be counterproductive. This is expecially true if expeditious resolution of these problems through the profit motive of Industry is the goal.

F. FINANCIAL IMPACT AND OTHER ACQUISITION STRATEGIES

For the ECASs discussed thus far, an attempt was made by the researcher via the Energy Questionnaire to determine from Industry (1) which ECASs the Government was already using and emphasizing in its acquisition of weapon system hardware related to energy conservation and efficiency, (2) the estimate of financial impact of these ECASs and, (3) other acquisition strategies that might be beneficial in enhancing energy conservation and efficiency. Responses to questions numbered six and seven of Section II of the Energy Questionnaire (Appendix A), were used as the source of data.

Industry indicated that the Government's use of the previously discussed acquisition strategies as ECASs was

minimal. Of the 21 respondents, eight indicated the use of LCC, followed by six for specifications, three for VICs, two for profit and zero for EESs. This data is summarized in Appendix F.

The estimated financial impact was minimal and is summarized in Appendix G. Industry indicated that all of the ECASs would result in cost increases with the average increase being about 2.58 percent. The highest increase was associated with specifications followed by LCC, EESs, profit and VICs.

In addition to the ECASs discussed above, Industry was asked to suggest additional strategies or techniques that might be beneficial for energy conservation and the acquisition of weapon system hardware. Although not all are considered to be acquisition strategies, the following suggestions were presented:

1. Less Government regulations.

2. Faster depreciation for energy conserving capital investment and DOD acceptance and enforcement.

3. More R&D programs to develop low power components and energy efficient heat transfer materials.

4. Increased tax considerations.

5. Increased aquisition and use of simulators to reduce flight hours.

6. A more liberal cost recovery program for independent, energy conservation R&D projects.

7. Increased use of award fee additives.

8. Energy conservation publications outlining experiences on various Government contracts where energy conservation

efforts worked. This would be supplied to all Government contractors upon contract award.

9. Broader dissemination of energy conservation measures related to military hardware.

10. More Government and Industry seminars to promote ideas and describe techniques.

Industry perceives the Government's use of ECASs as minimal, the financial impact of these strategies as minimal and sees the need for additional strategies and techniques to enhance energy conservation. The usage and financial data presented herein are only estimates and must, for the present, be taken on face value. Additional research is obviously necessary. Considering the large sums of money spent annually on weapon system hardware, effective strategies for enhancing energy conservation and efficiency in the acquisition process must be developed as soon as possible. Hopefully, this research will provide the start of a foundation upon which future ECASs may be developed.

V. ENERGY CONSERVATION MANAGEMENT PROGRAMS

The concept of Energy Conservation Management Programs (ECMP) deals with the development and management of programs by Industry to enhance energy conservation and efficiency within contractors facilities and by the contractor's personnel. The subject is becoming more and more critical because of the nation's energy shortages and because of

the ever-increasing prices of energy. The potential for energy conservation exists because of the following: [1:1]

1. Conservation measures once considered unnecessary or uneconomical are now desirable and cost effective.

2. Contractors have failed to commit adequate resources (dollars and personnel) because of competing demands.

3. Contractors have not made a comprehensive survey designed to identify areas of energy waste.

4. Conservation measures previously established are not being enforced because there is little appreciation of the need for energy conservation.

The efforts of various Government Agencies in addition to special interest groups within Industry will hopefully encourage the development of more ECMPs by more contractors. The following ECMP discussion will be based primarily on the results of the Energy Questionnaire and will be supplemented by information obtained from the current literature where available.

A. LEGISLATION AND IMPLEMENTATION

The primary legislation associated with the subject of ECMP is Public Law 94-163 dated 22 December 1975 and otherwise known as the Energy Policy and Conservation Act (EPCA). This Act also applies to the subject of ECAS, as previously discussed in Chapter IV, as well as, to Energy Crisis Contingency Planning (ECCP) which will be discussed in Chapter VI. This Act requires that: [29:Sec. 372]

> The Administrator (of the Department of Energy) shall establish and maintain, in conjunction with the Secretary of Commerce and the Administrator of the Energy Research and Development Administration, a

program - (1) to promote increased energy efficiency by American industry, and (2) to establish voluntary energy efficiency improvement targets for at least the ten most energy consumptive major energy consuming industries.

The Act goes on to require the chief executive officer of each energy consuming industry identified to report on the energy efficiency improvement that such corporation has made over the past year with the first report due 1 January 1977 and annually thereafter. Compliance with this reporting requirement is mandatory and the district courts of the U.S. have the jurisdiction, upon petition, to issue an order to the chief executive officer of any corporation failing to comply. Any failure to obey such order shall be treated as a contempt thereof.

The provisions of the EPCA were implemented via Executive Order 12003 dated 20 July 1977 and within DOD by DOD Directive 4170.10 [3:1] and DOD Instruction 4170.9 [5:1]. DOD Directive 4170.10 entitled "Energy Conservation" requires that the Secretaries of the Military Departments ensure the consideration of energy efficiency in both the production of the weapon system's hardware and the production facilities that are utilized.

It also requires that:

1. The Director of the Defense Logistics Agency shall: (a) encourage energy conservation practices among defense contractors in accordance with DOD Instruction 4170.9 and Defense Acquisition Regulation 1-339. [3:5]

2. The Director of the Defense Contract Audit Agency shall develop audit programs to assess contractor achievements in energy conservation. [3:5]

The purpose of DOD Instruction 4170.9 entitled "Defense Contractor Energy Shortages and Conservation" is as follows: [5:1]

> . . . assigns responsibility for implementing Department of Defense policies for coping with industrial energy shortages which impact on Defense products and <u>for encouraging energy conservation practices among defense contractors</u>. (Emphasis added)

It also requires the following: [5:3]

> In accordance with the Energy Policy and Conservation Act, DOD components shall encourage defense contractors to adopt energy conservation measures embracing the major areas of industrial energy usage, placing emphasis on high energy users.

The legislation and implementing instructions discussed above do at least recognize the importance of energy conservation and ECMPs and is an attempt by DOD to provide general guidance and policy. With regard to ECMPs specifically, this policy appears to be a good start, but unfortunately at present it also appears to be the end. The researcher was unable to find specific instructions within DOD concerning how ECMPs should be developed and managed by Defense contractors. There are, however, many publications initiated by both the Department of Commerce (DOC) and the Department of Energy (DOE) on energy conservation to which interested contractors may be referred.

Emphasis and support by DOD for the development and use of ECMPs is also not being done via the acquisition process

(i.e., DOD contracts). The researcher has not found any requirement for the development of ECMPs. The language concerning energy conservation contained in the DAR is basically general and vague and does nothing more than provide "lip service" to the subject. [32:2] Hopefully, as stated in Appendix D, DOD is in the process of modifying the appropriate directives to reflect increased management concern for energy efficiency during the acquisition process.

B. CRITICAL ISSUES OTHER THAN ENERGY

It has to be recognized that critical issues, other than energy conservation, are having a profound affect on Industry today. Of the 21 total respondents, 17 (81 percent) indicated that they considered a variety of other problems to be more important. Considering that the other four respondents did not answer the question, the consensus appears to be very strong regarding the relative priority of energy conservation.

The three primary issues raised by Industry other than energy were, in order of priority; inflation, the availability of quality materials and qualified labor and productivity. Nine respondents (43 percent) identified inflation, seven (33 percent) identified materials and labor and only three (14 percent) identified productivity. Although the researcher agrees that inflation is of great importance, the third place showing of productivity came as a surprise. The poor standing of the United States regarding

productivity rate increases compared to other nations is a matter of common knowledge. However, the reason for this poor standing could be a result of the relative priority being assigned by Industry to productivity as an issue. This is a purely subjective assessment made by the researcher based upon the Energy Questionnaire data.

Other issues that were presented as more important than energy conservation are as follows:

1. Obsolescence and maintenance of facilities and equipment.
2. Decreased R&D spending as a percentage of GNP.
3. Proliferation of Government regulations on Industry.
4. A general decline in the quality and quantity of suppliers.
5. Timely delivery of the product, project commitments and PROFIT!
6. The need for a comprehensive and competent National Energy Policy as opposed to stop gap energy conservation by Industry.

None of these issues cited by Industry are new to those involved in the acquisition process. Several are already being addressed in the acquisition process via various techniques. This is another big complaint of Industry. Many people would argue that the acquisition process is for the acquisition of quality goods and services at fair and reasonable prices and not for the support and attempted resolution of a myriad of complex national issues. [35:18] This has been cited as one of several reasons for increases in the costs of weapon systems hardware. The multitude of

issues being addressed in the acquisition process makes it difficult to establish what actual progress is being made on any one particular issue.

The relative priority of energy conservation cited by Industry has to be taken at face value, however, it should be noted that the sample size was small. A larger sampling of contractors may yield different results. It would appear that one viable method of increasing the relative priority of energy would be by increased Government emphasis on the subject. The voluntary efforts of Industry, although commendable in some cases, may not be enough to offset the escalating scarcity of energy supplies. Such a scarcity could have drastic effects on both the Nation's economy and the national defense.

C. INDUSTRY MANAGEMENT PROGRAMS

In 1977, GAO initiated a report stating that Federal agencies could do more to promote energy conservation by Government contractors. [33:i] The report stated that although several contractors appeared to be slowly developing ECMPs that none had implemented programs based upon the five elements advocated by the Federal Energy Administration (now DOE) and the Department of Commerce. These program elements are as follows: [33:15]

1. Top management commitment.
2. Development of comprehensive energy-use surveys.
3. Goal setting based upon survey evaluations.

4. Employee motivation campaigns.

5. Monitoring of program implementation and results.

On the basis of the questionnaire, it appears that Defense contractors have made progress in the last several years in the development and implementation of ECMPs. This progress is being monitored by the Defense Contract Audit Agency (DCAA) which initiated its energy conservation audit program in 1974 and has refined and improved it over the years. This audit program is an operations audit that requires observation and evaluation of the economy and efficiency of contractor operations. The DCAA's guidelines for conducting operations audits of energy conservation cite the following characteristics that experienced Government and Industry personnel have identified as indicative and necessary for an effective program: [1:2]

1. Top management commitment.

2. Accountability of line managers regarding their unit's performance related to energy conservation.

3. Formal planning - short and long range.

4. Monitoring - to correct weaknesses and identify strengths and successes.

5. Utilization of available technical expertise.

6. Employee awareness.

7. Contingency planning.

8. Resources support - availability of budget or personnel resources needed for energy conservation.

The Energy Questionnaire provides some data concerning Industry's status on ECMP development and implementation.

Of the 21 respondents, 100 percent stated that they had ECMPs in effect at their plants. The majority of the program elements cited by DCAA were also addressed. All of the respondents indicated that the ECMP enjoyed total management support in the following degrees: total - 38 percent; strong - 14 percent; good - 33 percent and adequate - 14 percent. There were no negative comments made on the management support of ECMPs. Approximately 86 percent (18 contractors) indicated that the ECMP was developed using comprehensive, energy-use surveys. Only 14 percent stated that these surveys were not utilized. Regarding a measurement system to determine and analyze the amount of energy conserved, 91 percent stated that such a measurement system existed and only nine percent revealed the lack of a system. Approximately 95 percent indicated that the system was effective. The use of specific goals and objectives was cited by 15 respondents (71 percent) and 14 of these indicated that the goals were updated annually. Approximately one-third of the contractors (29 percent) indicated that their ECMPs did not contain employee motivation campaigns. Monitoring and enforcement of these ECMPs were indicated by 71 percent of the respondents and of these, all felt that the enforcement was adequate or more than adequate.

All of the respondents agreed that the use of ECMPs had been successful in conserving energy within their plants. This data appears conclusive, however, the researcher is of

the opinion that a larger and more detailed review is necessary to confirm these results. It is surprising, however, that 100 percent of the respondents indicated the existence of an ECMP in view of the fact that problems, such as the following, exist to impede the ECMP's development: [33:20]

1. Overall cost of the programs.
2. Lack of qualified, full-time personnel.
3. Long payback of energy saving programs.
4. Competition of other projects for investment dollars.

Apparently, the cost and scarcity of energy in the competitive marketplace has succeeded in convincing some contractors that energy conservation and efficiency deserve considerable attention.

Once the ECMP is developed, the effective management of the program can be challenging and can also present problems. It is necessary, therefore, to assign an appropriate number of personnel to the task. Approximately 81 percent of the respondents indicated that they had a manager, a group of managers or a committee with the title of Energy Coordinator or something similar. The titles that were presented were varied but can be described as falling into the following areas: engineering, operations, facilities, property, planning and energy conservation and resources. These managers reported directly to higher level management with titles such as Corporate Vice-President of Operations or

Director, Facilities and Manufacturing. A good example of the Energy Coordinator's primary responsibilities is as follows:

1. Coordinate and leads company effort to improve energy utilization.

2. Establishes energy saving goals, develops plans to implement and reports progress to upper management.

3. Performs in-depth company audits and analyses of facilities and equipment.

4. Oversees company's energy consumption, record keeping and prepares reports.

5. Interfaces with employees at all levels to motivate greater energy awareness.

Of the total respondents, 47 percent indicated that the job of Energy Coordinator was a primary duty, 34 percent indicated collateral duty and 19 percent did not address the question. Approximately 52 percent indicated that the job was a staff position whereas 29 percent indicated it was a line position. The number of personnel assigned to the Energy Coordinator's staff varied with 57 percent of the respondents indicating less than five personnel and 24 percent indicating greater than five. The largest was an energy committee consisting of 22 personnel. The response to the annual budget of the Energy Coordinator was also varied, however, all responses were less than $1 million with the mode being approximately $500,000 per year. It should be noted that 76 percent of the respondents had sales in excess of $100 million per year. The amount budgeted for energy related issues was less than one-half of one percent.

The data presented in the Energy Questionnaire indicates that Industry has made considerable progress in the development, implementation and management of ECMPs. However, this progress was reported by the companies answering the questionnaire and could be biased. After discussing the subject of ECMPs with the four contractors interviewed, it was apparent that Industry's views of an effective ECMP were very broad. Only one of the four contractors interviewed had an ECMP that the researcher would classify as comprehensive such that it was based upon all of the program elements cited by DCAA and was supplemented by a crisis contingency plan. The others appeared to be mediocre programs that lacked company emphasis, as well as, the personnel necessary to manage them. No written documentation was presented to the researcher for these mediocre ECMPs and they did not appear to be based upon any specifically defined goals and objectives of the company relating to long term energy conservation efforts. The audits being conducted by DCAA are extremely important and should be emphasized and continued in the future. Hopefully, the quality and quantity of ECMPs in the Defense Industry will increase as DOD's emphasis and top management support of energy conservation and efficiency increases. Increased emphasis on these subjects via the acquisition process of weapon system hardware appears to be inevitable.

D. ENERGY CONSERVATION PROJECTS IN INDUSTRY

As part of the ECMP discussion, Industry was asked to present several energy conservation projects that were currently in process and several that were planned for the future. The projects that were presented indicated that most contractors were concentrating on basic "housekeeping" type improvements such as lighting modifications, improvements and standards, emphasis on heating, ventilation and air conditioning systems, energy management computers and various insulation projects. These projects were currently in-process and also planned well into the future.

Other projects that were currently in-process included the following:

1. Emphasis on carpooling including company acquisition of vans for employee use.
2. Boiler improvements.
3. Waste paper energy recovery systems.
4. Higher utilization of energy intensive processes.
5. Reducing hot water temperature and increasing chilled water temperature to reduce energy consumption.
6. Mandatory thermostat controls.
7. Opening and closing hangar doors in the winter and modifying engine test procedures to reduce run times.
8. Use of Pyrolytic Incinerators.

Future projects, separate and distinct from those already mentioned include:

1. Consolidation of facilities to reduce energy consumption.
2. Use of trash as fuel.

3. Installation of waste heat recovery systems on boilers.

4. Improvements and expansion of computerized energy management systems.

5. Installation of heat pumps using well water.

6. Insulation of fuel oil storage tanks.

Naturally, there are numerous other methods that can be employed in industry to conserve energy and there are a number of publications available on the subject from the Department of Energy (DOE), Department of Commerce (DOC) and the National Bureau of Standards (NBS). Some of these publications are as follows: [5:3]

1. NBS Handbook 115, Energy Conservation Program Guide for Industry and Commerce and NBS Handbook 115 Supplement No. 1.

2. The Energy Conservation Handbook for Light Industries and Commercial Buildings. (DOC)

3. The Total Energy Management Handbook. (DOC and DOE)

4. Lighting Handbook, Illuminating Engineering Society, Fifth edition, 1972.

Other possible references are identified in enclosure one to DCAA's "Guidelines for Operations Audits of Energy Conservation." [1:37]

E. GOVERNMENT ASSISTANCE AND INCONSISTENCIES

Energy conservation and efficiency has presented a very complex problem to Government, Industry and the Nation. From the research, it appears that every possible alternative and every potential solution is being explored. It is entirely possible that the Government should be doing more than it

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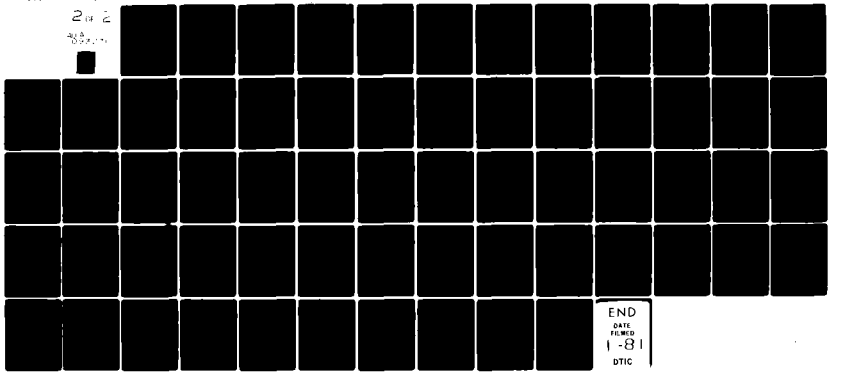


is at present to help Defense contractors develop viable ECMPs. Industry was asked to respond to a series of questions in the Energy Questionnaire to determine exactly what, if anything, the Government could and should be doing.

Regarding the distribution of more energy conservation related publications and materials, 48 percent of the respondents agreed, 24 percent were neutral and 24 percent disagreed. The suggested development and utilization of a wide variety of energy conservation standards and guidelines was not well received. Only 29 percent agreed, 19 percent were neutral and 48 percent disagreed. Much to the surprise of the researcher, 52 percent of the respondents agreed to the development of acquisition techniques to conserve energy. Only 24 percent disagreed and 19 percent were neutral. As would be expected, 81 percent of the respondents agreed to increasing financial incentives and surprisingly enough 15 percent actually disagreed. This data appears to indicate that Industry does not want further Government interference on the subject of energy conservation unless it concerns financial assistance to motivate conservation efforts.

Because of the multitude of potential actions that the Government could take to enhance energy conservation, Industry was asked to present alternatives to those discussed above. Only two alternatives were presented as follows:

1. Develop and encourage separate utility metering and charging for each department within a plant.

2. Encourage cogeneration through financial incentives and by guaranteed cogeneration energy supplies.

One respondent to the question on alternatives made the following comment:

> No additional effort by the Government is necessary or desired. Anything the Government gets involved in is too costly, too political and too punitive in its implementation.

This comment is indicative of the situation that with Government involvement and assistance comes the possibility of inconsistencies. This refers to instances of confusion and incongruity that arise when a Government program is implemented and has detrimental side effects on other programs. Industry was asked to identify what inconsistencies existed between the policies of energy conservation and the requirement of various Government organizations. The following were presented:

1. Although energy conservation and efficiency are of national importance, DOE programs for the development of alternative energy sources demonstrate no sense of urgency.

2. As is typical of the Government, recent company energy conservation efforts have been reduced due to the diversion of personnel to responding to similar but inconsistent Government reports for DOE, AFPRO and the company's energy conservation committee.

3. Energy goals are ill-defined. There has been no action by Government energy people and that action that has been taken has been duplicative and involves too much paperwork.

4. EPA and OSHA requirements increase energy consumption. The strict requirements of EPA can use tremendous amounts of energy for the results achieved. Government regulations often reduce productivity and efficiency and increase energy

consumption. Pollution control equipment consumes energy and raises costs and OSHA regulations limit worker usage. Cost is also ironically the principal factor in acquiring new business. The increased emphasis on the use of coal without relaxing EPA requirements and approval procedures is inconsistent.

5. DOD has a need for high performance weapon systems and this is in direct conflict with energy conservation. Additionally, most Government procuring organizations are not willing to include in their respective programs the appropriate costs of implementing energy policies.

6. Environmental constraints override exploration and production of available oil supplies and negate utilization of nuclear and coal resources.

7. DOD over-specifies its hardware. This can result in energy intensive manufacturing processes often being required, as well as high energy requirements in the processing area as a result of stringent EPA requirements. Most production process specifications were developed when energy was in surplus. These specifications need review to determine lower temperatures, pressures and other limits that can reduce energy requirements.

One respondent made the following appropriate comment:

Conservation is only a temporary stop gap. There is not enough emphasis on alternative energy sources such as cogeneration and nuclear. The lead time provided by large scale industrial conservation is fast running out.

The inconsistencies presented by Industry, as well as, the above comment are strong indicators of the complexity of the energy conservation problem facing the United States. In addition, they are also impediments to the effective development, implementation and management of viable ECMPs. These Government inconsistencies will create confusion and uncertainty among U.S. contractors as to the correct direction and emphasis of their ECMPs. It appears that the development of a sound, unified and consistent national energy policy is imperative and urgently needed.

F. ALTERNATIVE ENERGY SOURCE DEVELOPMENT BY INDUSTRY

The DOD directives that provide guidance for the acquisition of major systems are DOD Directive (DODD) 5000.1 and DOD Instruction (DODI) 5000.2. The former provides general policy on the subject while the latter provides general policy on the subject while the latter provides supplementing procedures for the implementation of the policy. Energy conservation and efficiency are addressed in various sections of DODI 5000.2. Regarding design considerations, this Instruction requires the following: [6:15]

> 1. System Energy Requirements. Energy requirements shall be considered in system selection and design. Major considerations shall be minimum energy usage and the substitution of other energy sources for petroleum and natural gas.

The requirements of minimum energy usage and the substitution and development of other energy sources for petroleum and natural gas are potential candidates for inclusion in the contractor's ECMP These requirements may apply to both the weapon system hardware and the production facilities utilized in the production process.

Industry was asked to respond to several questions pertaining to petroleum and natural gas usage and the substitution of alternative fuels regarding the hardware and the production processes. Regarding the production processes, 19 (91 percent) of the respondents stated that their plants relied on petroleum or natural gas to support its operations. Of this amount, 53 percent stated that their design engineers had developed strategies or methods for the possible substitution of other energy sources for petroleum or

natural gas and 47 percent indicated no action in this area. Some possible substitution strategies include the following:

1. Use of coal oil.
2. Use of propane backup systems.
3. Use of dual fuel boiler operations.
4. Use of electric boilers.
5. Use of refuse fired boilers.

Regarding the weapon system hardware, only 33 percent (seven respondents) stated that their weapon system relied on petroleum or natural gas for its operation. Of this amount, the majority (86 percent) indicated that their design engineers had not developed any strategies or methods for the possible substitution of other energy sources to support the hardware's operation. Of the 14 percent that did indicate the development of alternative energy sources, no strategies or methods were voluntarily presented.

The researcher's observation of this research data indicates that the large majority of contractors rely on petroleum or natural gas for their plant operations, however, very few have weapon systems hardware that rely on these sources. As a result, approximately half of the respondents have made progress on alternative sources for the production processes, but only a negligible number (one respondent) indicated the development of alternative energy sources for the hardware and no specifics were presented.

The support given by Industry to the development of alternative sources of energy could possibly be linked to the number of energy shortages experienced. Of the total respondents, 15 (71 percent) indicated that they had never experienced an energy shortage that affected their production. Of the 29 percent that had, the energy shortages consisted of voluntary reductions in natural gas and electricity consumption primarily to prevent brown-outs and shortages within metropolitan areas. These shortages were very short term in nature, usually lasting less than 24 hours. Because the United States has been experiencing energy shortages for the past seven years, the small number of respondents affected was surprising.

Industry's development of alternative sources of energy for petroleum and natural gas was not extensive, at least among the respondents. Major systems acquisition policy and procedures exist stating that substitution and energy usage shall be major considerations in system selection and design. Again, the data appears to indicate that more Government emphasis is necessary on this subject. As previously discussed, these factors could be major considerations in the development, implementation and management of ECMPs by Industry.

VI. ENERGY CRISIS CONTINGENCY PLANNING

The concept of Energy Crisis Contingency Planning (ECCP) refers to the development of contingency plans by Industry in anticipation of future energy shortages in order to minimize the impact on Defense acquisition programs. It is the policy of DOD to: [5:1]

1. Advise and assist Defense contractors experiencing energy shortages.

2. Recommend the use of the Defense Production Act of 1950, as amended, to obtain emergency relief during energy shortages only under conditions of extreme urgency.

3. Perform contingency planning in anticipation of energy shortages in order to minimize the impact on Defense acquisition programs.

4. Encourage energy conservation practices among Defense contractors in accordance with the Energy Policy and Conservation Act of 1975 and DAR 1-339.

The following discussion of ECCPs will be based primarily on the data derived from the Energy Questionnaire and the current literature, where available.

A. INDUSTRY CONTINGENCY PLANS

The Arab oil embargo of 1973-74, the natural gas shortage during the winter of 1976-77 and the threat of a lengthy coal strike during the 1977-78 winter has focused national attention on the need for viable ECCPs within both Government and Industry. [36:i] Regarding Defense contractors, DOD is "encouraging" the development of

contingency plans in anticipation of future energy shortages. This policy of "encouragement" means that at present, there is no contractual requirement for the development of ECCPs by the Defense Industry to the researcher's knowledge. In the absence of this requirement, DOD has provided the following guidance: [5:3]

> 1. In general, Defense contractors should be encouraged by DOD components to (a) develop contingency plans of their own in anticipation of energy shortages, (b) develop alternate energy resource capabilities, and (c) thoroughly familiarize themselves with the Federal, State and Local procedures for obtaining emergency relief from energy shortages.
>
> 2. In relation to the Priorities and Allocations authorities delegated under DOD Instruction 4400.1, DOD Components shall advise Defense contractors that DX and DO ratings assigned to contracts are not available for obtaining supplies of petroleum, gas, solid fuels and electricity. This is stated in Schedule II of the Defense Priority System (DPS) Regulation #1. Accordingly, the use of Special Priorities Assistance procedures as described in Section 12 of DPS Reg. 1 does not apply to the acquisition of energy resource allocations.
>
> 3. The validation or sponsorship of Defense contractor requests for relief from energy shortages which require action beyond the scope of DOD Component responsibility, such as requests for the invocation of the Defense Production Act, shall be submitted to the Under Secretary of Defense, Research and Engineering for evaluation and decision.

All of this intricate language indicates that Defense contractors are basically on their own regarding energy shortages, that the Defense Production Act of 1950 will be of little assistance and that if necessary, the matter can be escalated to higher levels. DODI 4170.9 also states that Defense contractors experiencing energy shortages are

responsible for taking every action necessary to prevent delays in contract performance by (a) resolving the problem locally, (b) implementing contingency plans, and (c) reporting the energy shortage to the appropriate procurement agency. The following information is also provided: [5:encl(1)]

> When informed of a Defense contractor energy problem, DOD components shall not assume responsibility or create the impression of willingness to assume responsibility for resolving the energy problem but should proceed as follows:
>
> 1. Advise the contractor to seek all possible assistance through local, state and Federal energy agencies.
>
> 2. Assess the impact of the problem on Defense production, implementing existing contingency plans where applicable. Consideration must be given to the (1) type items procured, (2) their relationship to urgent defense programs/operations, (3) impact of potential or actual delivery delays in the supply chain, and (4) ability to "live" with such delays.
>
> 3. If the potential/actual delivery delays cannot be tolerated, and all local remedial action has been exhausted, then the facts of the case should be escalated to the DOD component command level for further assessment/evaluation, and possible reporting to the Under Secretary of Defense, Research and Engineering (USD (R&E)) level by the responsible Industry Energy Officer. (emphasis added)

Therefore, although DOD is only "encouraging" the development of ECCPs by Industry, it has specifically tasked Industry with resolving potential or actual energy problems and intends to monitor the situation as it develops. It would appear that based upon this policy, justification exists for the possible contractual requirement of ECCP development by Defense contractors. It should be noted that the possible resolution of energy problems by DOD exists only

at very high levels (i.e., USD (R&E)) if it exists at all, and then only after consulting and cooperating with appropriate individuals within DOE and DOC. This administrative reporting system, as it exists now, is very frustrating, and could incur a time delay which could possibly exceed the duration of the actual energy shortage before a final decision is made. The researcher can attest to these "frustrations" based upon first-hand experience gained during the coal strike of 1977-78 while working on a particular DOD missile program.

Industry has indicated via the Energy Questionnaire that 71 percent of the respondents have ECCPs developed for their plants in the event of future energy shortages. This appears to be a healthy percentage considering that the DOD policy is not a firm requirement. Undoubtedly, the threat of future energy shortages and rising energy costs have made the development of ECCPs attractive, as well as, good business. The ECCP strategies that are being reviewed by Industry include the following:

1. The use of an alternative fuel source such as oil or coal and developing increased fuel storage facilities. Developing multi-source suppliers for heating oil.

2. Shifting work to other plants outside the geographic area affected by the energy shortage.

3. Altering the make or buy plan by increasing subcontracting where possible.

4. Eliminating additional work shifts when necessary. Closing plants on weekends. Minimizing environmental comfort by reducing the operating time of heating, ventilation and air conditioning systems, reducing lighting and establishing and enforcing mandatory thermostat controls. Possible closure of noncritical areas such as cafeteria, lounges, etc.

5. Possible transfers of fuel within the storage facilities of the corporation. Transporting fuel from other corporate sites, into the area affected by the energy shortage.

6. Use of dual fuel boiler operations and providing emergency electrical generators for key plant operations.

7. Attempting to ensure that most of the fuel utilized is Government furnished.

All of these strategies have merit because they represent viable alternatives to continue production and lessen the impact of an energy shortage. Some would be effective for 24 hours, some for a week and some for possibly a month. However, they are all basically short term in nature and their effectiveness depends upon the degree of implementation. The industry respondents stated that in the event of an energy shortage, these short term strategies would be exercised with a reversion to the original policies at the end of the energy shortage. Any extended energy shortage, for example over a month in duration, would probably render these strategies ineffective. This is also due to the degree of implementation. For example, if a contractor stores coal as an alternative energy source for use in an energy shortage, the duration of this particular contingency plan would be limited by available storage facilities and the amount of money the contractor is willing to spend on coal as a contingency. The contingency plan would, therefore, be short term in nature and would be rendered ineffective in an extended energy shortage. One respondent made the following comment:

> The nature and duration of long range shortages can be so varied it is impractical to preplan all contingencies. Efforts since 1979 by local industry groups have been to ensure that local utilities and legislators plan for adequate sources of electricity.

This comment reflects the short term characteristics of ECCPs. Any extended energy shortage will undoubtedly have severe affects on production.

Concerning the development and management of ECCPs, 16 contractors (76 percent) stated that they had a manager within their plant responsible for the execution of the ECCP. Of this amount, 81 percent stated that this manager was the same manager responsible for the ECMP. Therefore, the previously discussed information regarding principal responsibilities, primary or colateral duty, staff or line position, size of staff and budget allocation associated with ECMPs can also be applied to ECCPs.

It is interesting to note that only five respondents (24) percent) indicated that their ECCP required execution as a result of an actual energy shortage. Of these, all stated that the exercise had been successful because production was not negatively impacted by the shortage. One of the contractors interviewed made the following comment:

> We can plan all we want but in the long run, we are at the mercy of the public utilities.

B. GOVERNMENT ASSISTANCE AND ENERGY RATIONING

Industry appears to be somewhat divided on the subject of more Government assistance related to ECCPs. Of the total

respondents, only 24 percent agreed that the Government should be doing more to help contractors develop viable ECCPs, 29 percent disagreed and 33 percent were neutral. Three contractors (14 percent) elected not to address the question. Industry presented the following alternatives that could be explored by the Government relating to ECCPs:

1. Provide dollar incentives for the installation of backup energy supplies and cogeneration. Possible development of procedures for Government furnished fuel.

2. Relax or stretch out environmental standards that adversely impact upon energy conservation.

3. Reduce complexity of DOE regulations.

4. Reduce the number of inconsistencies that exist within various Government organizations.

5. Establish clear priority allocations of energy supplies to improve public transportation in the area.

6. Continually assess the probability of future energy shortages in various geographic areas and industries. Develop quantitative guidelines on production losses versus electricity or fuel shortages for each SIC and convey the results to management.

These comments are very broad and general and would appear to apply to additional subjects other than ECCPs. However, they could be appropriate candidates for further Government investigation. One additional area might be that of state sovereignty and energy rationing. As previously discussed, the Defense Production Act of 1950 does not apply to obtaining supplies of petroleum, gas, solid fuels and electricity. Although a Defense contract can span the boundaries of a state by connecting a particular contractor with a particular Government procurement agency, problems do exist with how

energy will be rationed within the state if a shortage occurs.

The respondents to the Energy Questionnaire were asked to indicate if their plants would have priority over other energy consumers if energy was rationed or allocated. Only 38 percent stated that they would have priority, 48 percent stated that they would not have priority and three contractors (14 percent) did not address the question. Those respondents who did not have priority presented the following higher priority consumers:

1. State and local Government facilities.
2. Residential areas.
3. Hospitals.
4. Public transportation.
5. Police and fire departments.
6. Schools.
7. Farms and food distribution activities.

It is interesting to note that 43 percent of the respondents indicated that they had DX rated systems under production. This percentage is very close to the 38 percent who indicated they had energy rationing priority over other energy consumers. Although the DX rating is supposedly not applicable in obtaining energy supplies, it undoubtedly helps high-level individuals within DOD, DOE AND DOC justify increased energy allocations depending upon the urgency and national importance of the weapon system program being affected by the energy shortage.

The percentage reduction in primary production energy sources that can be sustained by Industry without impacting production appears to be small. Nine respondents (43 percent) indicated that they could only sustain a ten percent maximum reduction without sustaining a production impact. Six respondents (29 percent) indicated a 20 percent maximum reduction and three indicated a 30 percent reduction. Three contractors did not respond to the question. This data appears to support the need for an expeditious system to review, evaluate and decide upon emergency energy priorities and allocations.

C. ADVANTAGES AND DISADVANTAGES

Industry presented the following advantages regarding the development of ECCPs:

1. The development of ECCPs forces a contractor to keep abreast of energy technology developments and enhances the use of effective energy conservation measures. The ECCP is a valuable part of the ECMP.

2. The ECCP enhances the contractor's awareness and preparation for future energy shortages. It is a form of prior planning that prevents poor performance. It increases the contractor's preparedness for natural or physical disasters such that more alternatives are evaluated in advance and are ready for immediate implementation and execution.

3. Development of the ECCP establishes personnel contacts for implementation and execution. It avoids lack of direction in the absence of key personnel.

4. The ECCP sets priorities and identifies critical areas in the plant. It helps to avoid worse disruptions and provides a well thought out strategy. It will provide a determination of the amount of energy curtailment the plant can sustain and still operate.

5. An ECCP will provide continuity of operation, will minimize layoffs, and will hopefully minimize production losses. It will assist the contractor in meeting required delivery dates.

6. The advanced planning aspect of an ECCP in order to minimize the chaos of future energy shortages makes it cost effective.

The disadvantages presented were as follows:

1. There are a wide variety of possible situations that could occur from an energy shortage and it is impossible and impractical to attempt to plan for all of them.

2. It is difficult to gather reliable information on which to base an ECCP. There is also a lack of effective, alternative strategies that would not be affected by the energy shortage.

3. Once developed, the ECCP may not be applicable to the specific situation. The plan must be frequently updated due to changing supply situations which involves the cost of development, implementation and maintenance. It is a cost to the contractor without compensation.

4. The development of an ECCP is time consuming and costly. Layoffs will be inevitable and depending upon the nature and duration of the energy shortage, production will inevitably be impacted.

5. Priorities are continuously changing such that critical areas cannot always be identified. There are too many unknowns that render the ECCP ineffective.

Considering that 71 percent of the respondents have developed ECCPs for their respective plants, to a majority of those surveyed the advantages apparently outweigh the disadvantages. As more research is done on other potential energy sources the alternatives available for ECCPs will increase. The development of ECCPs by Industry, as well as, their sophistication and complexity will also probably increase. This increased utilization and development could be enhanced

by additional Government emphasis on ECCPs. It is interesting to note that although DCAA's "Guidelines for Operation Audits of Energy Conservation" addresses the need for contingency planning, the subject is not emphasized at all and no specific audit instructions are presented as to what constitutes an acceptable or unacceptable ECCP. This type of information would be very beneficial to Industry in developing viable ECCPs.

VII. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The focus of this research was to evaluate the critical factors attendent to the issues of energy conservation and efficiency relating to the process of major systems acquisition as viewed by the U.S. Defense Aerospace Industry. The increased visibility that will result from this and future research, will hopefully culminate in the development and implementation of specific policies and procedures by which acquisition officials can effectively operate. The following conclusions address the research questions in the order that they are presented in Chapter I and are based upon the Energy Questionnaire data and the current literature.

Conclusion #1 - The issues of energy conservation and efficiency in the acquisition of weapon systems hardware and the production processes associated therewith must be given top priority.

As demonstrated in Chapter II, the United States has been subjected to several energy shortages from the Arab oil embargo

of 1973 to the present. These shortages, combined with the presently unstable situation in the Middle East, the increasing dependence of the United States on foreign oil and the uncertainty of future energy shortages and prices, has made the future of the world and this nation regarding energy very precarious. The United States' economy and the national defense have been drastically affected by the high cost and supply uncertainty of energy. DOD is the nation's single largest user of energy and Industry is the Nation's largest energy consuming sector. The large amounts of energy and dollars that are expended in acquiring the thousands of items upon which the United States' military forces are dependent dictates that energy must be considered as a primary acquisition factor.

Conclusion #2 - <u>Although considerable potential exists for energy conservation during the weapon system acquisition process, it is not being effectively realized because of vague policy and the lack of specific procedures and instructions</u>.

As discussed in Chapter III, current legislation in effect today requires that the principles of energy conservation and efficiency be considered in the acquisition of property and services by the Federal Government. This policy was implemented via Executive Order and was included in a policy letter by the Office of Federal Procurement Policy. The Defense Acquisition Regulation contains language pertaining to energy conservation and DOD has addressed the issue in several

key directives and instructions. It has taken seven years to develop all of this very vague and general legislation and implementing language and the result has been a very undefined and often conflicting approach concerning how energy should be addressed in the acquisition process. At present, the concepts of energy conservation and efficiency in the system acquisition process have little impact on system selection, design or development. No specific procedures, guidelines or instructions have been issued to contracting officers or program managers regarding the development, application, monitoring and enforcement of energy conservation in the acquisition cycle. The development and implementation of a comprehensive national energy policy is imperative and is urgently required.

Conclusion #3 - Several Energy Conservation Acquisition Strategies (ECAS) exist that could be used to enhance energy conservation and efficiency in the acquisition of weapon system hardware, but DOD is not using them to accomplish this goal.

The sheer existence of the conservation strategies discussed in Chapter IV and recognition of their energy conservation potential dictates their prompt investigation and consideration by the Department of Defense (DOD). However, at present, appropriate emphasis and top management support of these ECASs within DOD is definitely lacking. Specific instructions and procedures for program managers and contracting officers do not exist concerning when and how to

apply these acquisition techniques. Life Cycle Costing, Energy Efficiency Standards, Specifications, Value Incentive Clauses and Profit are all existing acquisition strategies that could be used more in the future to enhance energy conservation and efficiency. Industry has agreed that these strategies, with the exception of Energy Efficiency Standards, would be effective in analyzing and hopefully reducing the energy consumption of weapon systems hardware and the production processes associated therewith. However, it should be noted, as indicated in Appendix H, that although a majority does exist for most acquisition strategies, there are a large number of contractors that are neutral on this subject. More accurate and complete guidance is necessary regarding energy conservation costs and benefits, as well as, which ECASs should be employed. In some cases, the costs may outweigh the benefits. Industry has presented its views. More work is now required within DOD regarding energy conservation and ECASs.

Conclusion #4 - Industry has made considerable progress on the concept of Energy Conservation Management Programs (ECMP).

All of the questionnaire respondents indicated the existence of an ECMP based upon DCAA guidelines. Although ECMPs are not a contractual requirement for Defense Contractors, DOD has encouraged their development and implementation. The quality and sophistication of Industry's ECMPs varies considerably. This variance could be caused by the

lack of DOD emphasis and guidance on the subject. It must be recognized that Industry is attempting to cope with a number of important issues other than energy conservation such as spiraling inflation and poor productivity. Also, various inconsistencies exist between various Government agencies that tend to detract from the credibility of the Government's overall energy conservation initiatives. However, regardless of these other issues and inconsistencies, it is inevitable that as the cost and scarcity of energy increases, DOD's emphasis on ECMPs will also increase. As the recognition of energy conservation related to the national defense increases, the probability of ECMPs becoming a firm contractual requirement will also increase.

Conclusion #5 - Energy Crisis Contingency Planning (ECCP) is prevalent in Industry and is recognized as an important and effective method of planning to minimize the production impact of future energy shortages.

The development of ECCPs is not required by DOD but is encouraged. However, the DOD system designed to identify, evaluate and hopefully resolve potential, industrial energy shortages is cumbersome and frustrating and requires improvement to enhance expeditious action. DOD will not assume responsibility for industrial energy shortages but will advise contractors where necessary and escalate the problem to higher levels of authority for review and evaluation. ECCPs are effective in the short term but are ineffective as the

duration of the energy shortage increases. Only a very small percentage of Industry has experienced an actual energy shortage and accordingly not all are convinced of the need for ECCPs and further Government assistance on the subject. The increasing cost and scarcity of energy is forcing Industry to develop ECCPs. These factors, in addition to Government support, will increase the quantity, quality and effectiveness of Industry's ECCPs in the future. As the impact and importance of energy conservation related to the national defense increases, DOD's emphasis of ECCPs will also increase and may inevitably evolve into a contractual requirement for Defense contractors.

Conclusion #6 - Energy Conservation Acquisition Strategies, Management Programs and Contingency Plans form an effective, interdependent triad that must be included as component parts of a overall comprehensive energy conservation program.

This Energy Conservation Triad will enable DOD to enhance Industry's energy conservation in the aqusition process, as well as, intelligently cope with the uncertainty and potential production impact of future energy shortages. All of the component parts of the triad must be included for the energy program to be effective. The acquisition strategies will interject the issue of energy conservation into the acquisition process. The management programs will help to increase, accelerate and incentivize Industry's energy conservation efforts and the contingency plans will improve the planning

process for the uncertain energy future that lies ahead. The magnitude and importance of these three concepts dictates increased investigation, evaluation and support by DOD.

B. RECOMMENDATIONS

As a result of this research effort, the following recommendations pertaining to energy conservation and major weapon systems acquisition are offered:

Recommendation #1 - The Office of Federal Procurement Policy (OFPP) should revise and strengthen its policy letter on Federal procurement policy concerning energy conservation.

This recommendation was made previously by the General Accounting Office (GAO) but has experienced strong opposition in OFPP. The revised policy letter should cite the use of specific acquisition strategies, such as the ECASs discussed herein. Other actions, such as the development and implementation of ECMPs and ECCPs should be identified by OFPP and required for use, where appropriate, by the procurement agencies. The revised policy letter will help to strengthen the language contained in the Defense Acquisition Regulation and will assist in the development of specific and concise implementation procedures by the procurement agencies.

Recommendation #2 - The Office of the Secretary of Defense (OSD) should revise and prioritize the language contained in DODI 5000.2 that pertains to system energy requirements as a design consideration.

The role of energy should be strengthened and prioritized among the other design considerations. Energy conservation and efficiency should be primary considerations in the Mission Element Need Statement and in all subsequent Decision Coordinating Papers. It should be a primary factor in system selection, design and development that is emphasized and enforced by the Defense Systems Acquisition Review Council (DSARC). The revised language would require the consideration of energy by the program managers and the DSARC to a greater extent than is being done presently. OSD should continue to conduct in-house studies or sponsor studies by the Logistics Management Institute or others to investigate and evaluate the feasibility of using various ECASs on various weapon systems.

Recommendation #3 - The Defense Acquisition Regulation (DAR) Council should revise and strengthen the vague and general language contained in DAR 1-339.

This new language should be based upon the recommended changes to the OFPP Policy Letter and should be consistent with the inevitable, future importance of energy conservation in weapon systems acquisition relating to the national defense. It would enable and simplify the development and implementation of specific energy conservation procedures by the procurement agencies.

Recommendation #4 - The Defense Contract Audit Agency (DCAA) should continue to monitor contractors efforts on Energy Conservation Management Programs and Contingency Plans.

This monitoring by DCAA will help to maintain a high level of awareness and concern for energy conservation in Industry. Management programs are being addressed satisfactorily but more emphasis is needed on contingency planning by DCAA. This subject should be addressed more extensively in DCAA's "Guidelines for Conducting Operations Audits of Energy Conservation."

Recommendation #5 - Department of Defense Procurement Agencies should investigate and evaluate which acquisition strategies should be implemented based upon the type of hardware being procured.

Specific procedures and guidelines covering the appropriate application, implementation, monitoring and enforcement of these ECASs should be developed for program managers and contracting officers. These procedures should be based upon the recommended revisions to the OFPP Policy Letter and DAR 1-339. Once developed and implemented, the use of these ECASs by acquisition personnel must be monitored and enforced.

Recommendation #6 - The General Accounting Office (GAO) should continue to review and scrutinize the progress of the Department of Defense (DOD) in developing and emphasizing the use of the Energy Conservation Triad in weapon systems acquisition.

The increased visibility and organizational pressure by GAO will hopefully stimulate and improve DOD's awareness and accelerate its progress regarding these three very important issues.

C. AREAS OF FUTURE RESEARCH

The following areas of future research are offered:

1. The viability and effectiveness of selected acquisition strategies for conserving energy should be investigated and evaluated within the Federal Government. Industry has presented its views. The views of Government personnel are now required.

2. The development and implementation of specific contractual clauses to motivate, incentivize or require Defense Contractors to conserve energy should be investigated. The possible contractual requirement of Energy Conservation Management Programs and Contingency Plans should be evaluated within the Government.

3. Energy as a factor in weapon systems acquisition should be investigated among other contractors outside of the Defense Aerospace Industry. A large sample size should be employed and should include contractors with varying sales volumes and with varying percentages of Defense/Commercial business.

The problem of energy conservation facing the United States is one of tremendous scope and complexity. Considerable research and continuous support by Government, Industry and the American people will be required if a resolution is to be attained.

APPENDIX A

ENERGY QUESTIONNAIRE

NAVAL POSTGRADUATE SCHOOL
Monterey, California

The purpose of this questionnaire is to collect data from the Defense Aerospace Industry concerning Energy Conservation Acquisition Strategies (ECAS), Energy Conservation Management Programs (ECMP), and Energy Crisis Contingency Planning (ECCP). The Energy Questionnaire is divided into three sections. Section I pertains to Background Information related to your company. Section II pertains to ECAS relating to the acquisition of weapon systems hardware. Section III pertains to ECMP and ECCP related to the production processes and techniques utilized by your plant to manufacture these weapon systems.

THE ANSWERS TO THIS QUESTIONNAIRE WILL BE HELD IN THE STRICTEST CONFIDENCE. THE RESULTS OF THIS RESEARCH WILL NOT REFLECT ANSWERS RECEIVED FROM SPECIFIC COMPANIES OR INDIVIDUALS. THE RESULTS WILL BE NON-ATTRIBUTIVE.

Please answer all the questions. Comment or elaboration on any of your answers is strongly encouraged. Your assistance and cooperation in completing and returning this questionnaire is extremely important and will be greatly appreciated. A return envelope is enclosed for your convenience.

RESPONSES ARE NEEDED NO LATER THAN 7 July 1980. EARLIER RESPONSES ARE ENCOURAGED.

SECTION I - BACKGROUND INFORMATION

1. What is your Standard Industrial Classification Code (SIC)? SIC Various

2. What approximate percentage of your facilities (plant and equipment) are Government owned?

17 0-25% 2 26-50% 1 51-75% 1 76-100%

3. What are your total annual sales and what percentage of these sales are related to Defense?

Annual Sales	Percentage Related to Defense
0 under $1M	1 under 10%
1 $1M - $10M	0 11-25%
4 $10M - $100M	1 26-50%
16 above $100	4 51-75%
	15 76-100%

4. With what Department of Defense (DOD) Agency do you conduct most of your business?

2 Army 9 Air Force 6 Navy 0 Marine Corps

0 Defense Logistics Agency

5. What is the principal type (i.e., natural gas, water, oil, coal, nuclear) of energy used by the power plant that supplies the electricity necessary to operate your plant? If other, please specify._____

6. If your plant uses other than electricity for its operations, please specify. Natural Gas, Oil, Propane

7. In which state is the power plant located that supplies the electricity necessary to operate your plant?
Same State 100%

SECTION II - ENERGY CONSERVATION ACQUISITION STRATEGIES (ECAS)

NOTE - ALL QUESTIONS IN SECTION II, WITH THE EXCEPTION OF THOSE RELATED TO PROFIT, PERTAIN TO THE ACQUISITION OF WEAPON SYSTEMS HARDWARE AND THE COSTS ASSOCIATED THERETO. THEY DO NOT PERTAIN TO THE PRODUCTION PROCESSES AND TECHNIQUES NECESSARY TO MANUFACTURE THE HARDWARE.

1. LIFE CYCLE COSTING (LCC)

   a. Do you consider and include the cost of energy as a part of your LCC calculations relating to the acquisition of weapon systems hardware? 13 YES 7 NO. If yes, do you have an individual or group of individuals assigned the responsibility of analyzing and calculating the cost of energy as part of the life cycle of the hardware?
   9 YES 4 NO

b. LCC represents an effective Energy Conservation Acquisition Strategy (ECAS) that should be used in the future to analyze and hopefully reduce the operational energy consumption of weapon systems hardware.

3 strongly agree (S.A.) 9 agree (A.) 5 neutral (N.)

3 disagree (D.) 0 strongly disagree (S.D.)

c. What do you see as the three most significant advantages and disadvantages of using LCC as an ECAS relating to the acquisition of weapon systems hardware?

2. ENERGY EFFICIENCY STANDARDS (EES)

a. EESs represent an effective ECAS to conserve energy associated with weapon systems hardware.

2 strongly disagree (S.D.) 4 disagree (D.) 8 neutral (N.)

6 agree (A.) 0 strongly agree (S.A.)

b. Has DOD applied any EESs to the system(s) that you are now designing or manufacturing? 3 YES 15 NO

c. Do you impose EESs upon your subcontractors? 3 YES 16 NO

d. What do you see as the three most significant advantages and disadvantages of EESs related to the acquisition of weapon systems hardware?

3. DESIGN vs. PERFORMANCE SPECIFICATIONS

a. The use of Design Specifications represents an effective ECAS that should be used more frequently in the future to reduce the operational energy consumption of weapon systems hardware.

0 S.A. 10 A. 5 N. 3 D. 2 S.D.

b. The use of Performance Specifications represents an effective ECAS that should be used more frequently in the future to reduce the operational energy consumption of weapon systems hardware.

4 S.D. 3 D. 5 N. 8 A. 0 S.A.

c. What do you see as the three most significant advantages and disadvantages of the type of specification you selected in (a) or (b) as the most effective ECAS related to the acquisition of weapon system hardware?

4. VALUE INCENTIVE CLAUSES (VIC)

a. Do you have VICs in any of your current Defense Contracts? 14 YES 4 NO

b. Have you ever formulated and submitted a VECP related to energy conservation or efficiency? 2 YES 17 NO

c. VICs represent an effective ECAS that should be used more frequently in the future to reduce the operational energy consumption of weapon systems hardware.

1 S.A. 9 A. 6 N. 1 D. 3 S.D.

d. What do you feel are the three most significant advantages and disadvantages of the use of VICs as an ECAS related to the acquisition of weapon systems hardware?

5. PROFIT CONSIDERATIONS

a. Profit can be used as an incentive for the Defense Industry to conserve energy related to the acquisition of weapon systems hardware and the production processes associated therewith.

3 S.D. 3 D. 3 N. 10 A. 1 S.A.

b. The increased emphasis in the Weighted Guidelines on facilities investment will motivate contractors to invest in facilities that are energy efficient in order to conserve energy in weapon systems production.

0 S.A. 9 A. 3 N. 5 D. 2 S.D.

If you disagree, what would the facilities investment factor have to be to provide the proper incentive?

Various

If increased emphasis on facilities investment is not the answer what alternative(s) would you recommend?

c. The -5 to +5 percent factor for energy conservation as a special factor on the Weighted Guidelines provides an incentive for contractors to develop innovative ideas for conserving energy.

2 S.D. 5 D. 5 N. 7 A. 0 S.A.

If you disagree, what would the factor have to be to provide the proper incentive?

d. The use of profit to motivate industry to conserve energy is an effective ECAS that should be emphasized more in the future.

2 S.A. 8 A. 4 N. 5 D. 0 S.D.

If you disagree, what other financial incentives, other than profit (i.e. accelerated depreciation, tax considerations, etc.) would you consider to be proper incentives for Industry to conserve energy? Please list several.

e. What do you view as the three most significant advantages and disadvantages of using profit as an ECAS related to the acquisition of weapon systems hardware?

6. FINANCIAL IMPACT

a. Relating to energy conservation, which of the ECAS discussed above are already being used in the Government's acquisition of your weapon systems hardware? Please check appropriate blocks.

8 LCC 0 EES 3 VIC 6 SPECS 2 PROFIT

b. Do you feel that the use of these ECAS will have a financial impact upon the unit cost of the system(s) that you are now designing or manufacturing?
11 YES 3 NO. If yes, please indicate your estimate of this financial impact for each ECAS listed below.

	PERCENTAGE INCREASE					
ECAS	0	0-1	1-3	3-5	Above 5	MEAN
LCC	1	2	1	3	2	2.78
EES	0	1	2	1	1	2.70
VIC	0	3	0	3	0	1.86
SPECS	0	1	2	3	2	3.31
PROFIT	0	2	0	2	0	2.25
					AVG.	2.58

7. OTHER ACQUISITION STRATEGIES

In addition to the ECAS discussed above, what other strategies or techniques do you feel would be beneficial for energy conservation and the acquisition of weapon systems hardware? Please list several.

SECTION III - ENERGY CONSERVATION MANAGEMENT PROGRAMS (ECMP) AND ENERGY CRISIS CONTINGENCY PLANNING (ECCP)

NOTE: THE QUESTIONS IN SECTION III PERTAIN TO THE PRODUCTION PROCESSES, TECHNIQUES, ETC., THAT ARE UTILIZED BY YOUR PLANT TO MANUFACTURE THE WEAPON SYSTEMS HARDWARE.

1. Do you consider any other problems (i.e., inflation) to be more important than energy conservation? 17 YES 0 NO. If yes, please list in descending order of importance:

2. Do you have an Energy Conservation Management Program (ECMP) in effect at your plant? 21 YES 0 NO. If yes, please answer the following. If no, skip to question III (3).

   a. In your opinion, what top management support does the ECMP enjoy?

      8 total 7 good 0 neutral 3 strong

      3 adequate 0 little

   b. Was the ECMP developed through the use of comprehensive energy use surveys that pertained to the entire plant? 18 YES 3 NO

   c. Does the ECMP contain a measurement system to determine the amount of energy conserved and provide a measure of effectiveness? 19 YES 2 NO. If yes, what is your opinion of the effectiveness of the ECMP measurement system?

      3 highly effective 8 effective 7 adequate

      1 ineffective 0 highly ineffective

   d. Does the ECMP contain specific goals and objectives that are based upon the energy use surveys? 15 YES 6 NO. If yes, are the goals and objectives updated annually on the basis of current energy use surveys? 14 YES 1 NO

e. Does the ECMP include employee motivation campaigns?
15 YES 6 NO

f. Does the ECMP contain a system to monitor and enforce the energy conservation techniques that are employed?
15 YES 6 NO. If yes, is this system effective?

2 highly effective 10 effective 3 adequate
0 ineffective 0 highly ineffective

g. In general, the ECMP has been successful in conserving energy within your plant.

0 S.D. 0 D. 0 N. 12 A. 9 S.A.

3. If no ECMP has been established, which of the following do you view as the major impediment to its establishment? (Check only one)

0 overall cost of the program
0 lack of qualified, full-time personnel
0 reluctancy to invest in energy saving programs or equipment unless quick payback
0 competition of other investment projects for funds
0 other, please explain

4. Do you have a manager, group of managers, or a committee with the title of Energy Coordinator(s) or something similar? 17 YES 4 NO. If yes, please provide short answers for the following. If no, skip to question III (5).

a. What is his/her official title? Various
b. To whom does he/she report? Various
c. List his/her five principal responsibilities or duties:

d. Is the job considered to be a primary job or a collateral duty? 10 primary 7 collateral
e. Is the job staff or line? 11 staff 6 line
f. How many people are on the Energy Coordinator's staff? Various
g. How large of an annual budget does the Energy Coordinator have to successfully accomplish his/her primary responsibilities? Various

5. Please list three significant energy conservation measures that are presently in process and three that are planned for the future within your plant.

6. The Federal Government should be doing more to help Defense Contractors develop viable ECMPs through the use of the following:

   a. Distributing more energy conservation related publications and materials.

      3 S.A. 7 A. 5 N. 2 D. 3 S.D.

   b. Developing and utilizing a wide variety of energy conservation standards and guidelines.

      3 S.D. 7 D. 4 N. 6 A. 0 S.A.

   c. Developing and utilizing acquisition techniques to conserve energy.

      0 S.A. 11 A. 4 N. 3 D. 2 S.D.

   d. Increasing financial incentives.

      2 S.D. 1 D. 0 N. 7 A. 10 S.A.

   e. Other (please explain).

      Various

7. What inconsistencies do you believe exist between the policies of energy conservation and the requirement of various Federal Government Organizations?

   Various

8. Has your plant ever experienced an energy shortage that affected your production? 6 YES 15 NO. If yes, briefly describe.

9. Does your plant rely on petroleum or natural gas for its production processes or operations? 19 YES 2 NO. If yes, have your Plant Engineers developed any strategies for the possible substitution of <u>other</u> energy sources for the petroleum or natural gas to support these production processes and operations? 10 YES 9 NO. If yes, please list several strategies.

10. Does the weapon systems hardware that you are producing require the use of petroleum or natural gas for its operation? 7 YES 13 NO. If yes, have your Systems of Design Engineers developed any strategies for the possible substitution of other energy sources for the petroleum or natural gas related to the hardware's operation? 1 YES 6 NO. If yes, please list several strategies.

11. Do you have an Energy Crisis Contingency Plan (ECCP) developed for your plant in the event of an energy shortage? 15 YES 6 NO. If yes, please list five strategies (i.e., alter make or buy, shift work to other plants) that you have considered in order to cope with the energy shortage and adhere to your contractual commitments.

12. Do you have a manager within your plant responsible for the development and implementation of the ECCP? 16 YES 5 NO. If yes, is he the same manager responsible for the ECMP? 13 YES 3 NO

13. Have you ever had to implement your ECCP as a result of an energy shortage? 5 YES 14 NO. If yes, was it successful? 5 YES 0 NO. If no, what were the main problem areas?

14. The Federal Government should be doing more to help Defense Contractors develop viable ECCPs.

    0 S.A. 5 A. 7 N. 2 D. 4 S.D.

    If agree, please list three possible improvements:

15. Is your firm currently producing any DX rated systems? 9 YES 8 NO

16. If energy was allocated or rationed as a result of an energy shortage, would your plant have priority over other energy consumers? 8 YES 10 NO. If no, list three consumers that would have a higher priority than your plant?

17. What percentage reduction in your primary production energy source could you sustain without adversely impacting production.

    9 0-10% 6 11-20% 3 21-30% 0 31-40%

    0 41-50% 0 above 50%

18. What do you view as the three most significant advantages and disadvantages associated with ECCP?

In the event that clarification of certain answers is deemed necessary, would a representative of your company be willing to discuss these answers with the researcher via telephone? ____YES ____NO. If yes, please provide the name, official position or title and telephone number of the person(s) to be contacted and the section of the questionnaire over which they have cognizance.

Name _____ Name _____ Name _____

Title_____ Title_____ Title_____

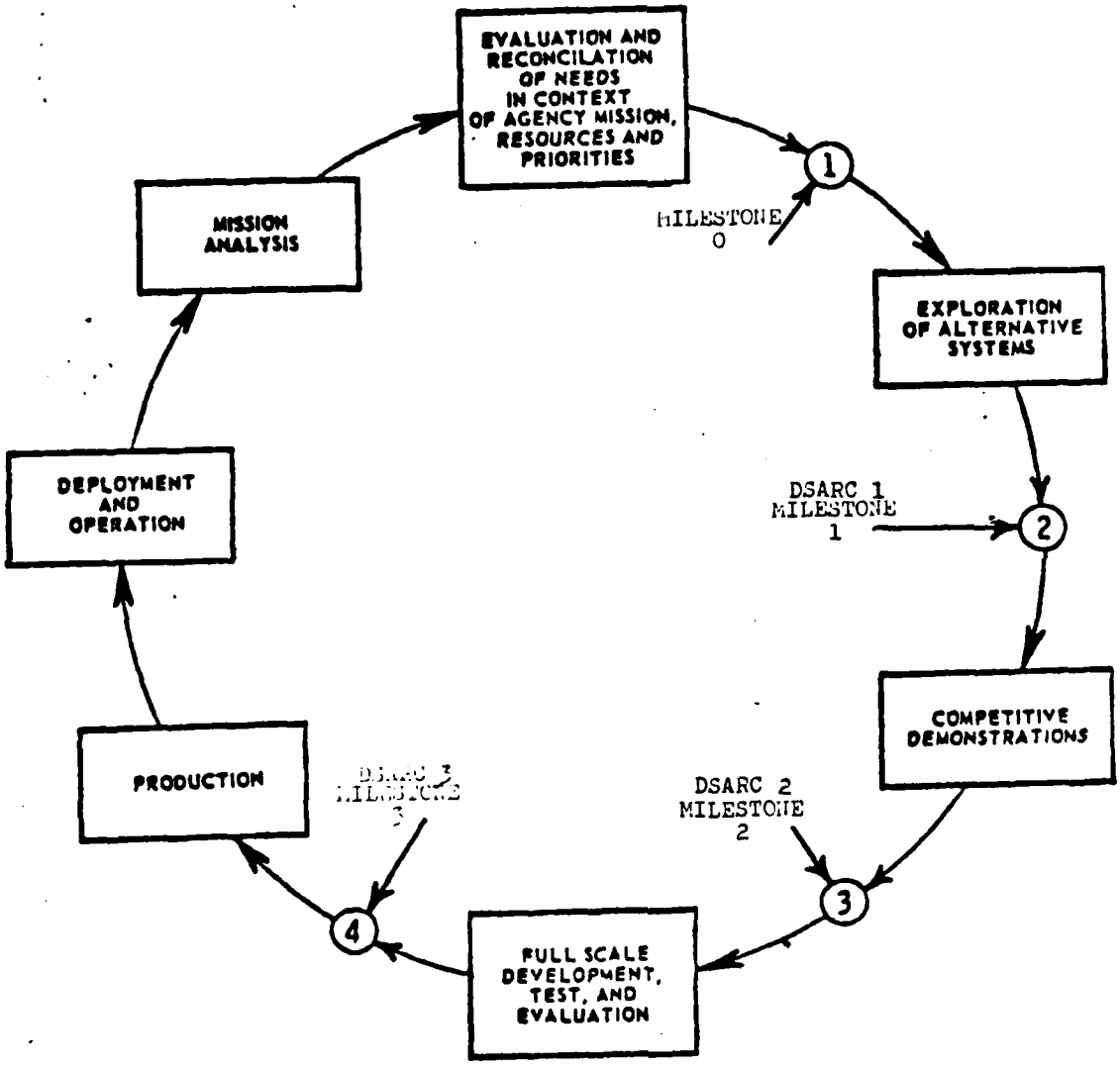
Tel No. _____ Tel. No._____ Tel. No._____

Section _____ Section_____ Section_____

THANK YOU VERY MUCH FOR YOUR TIME AND COOPERATION IN COMPLETING AND RETURNING THIS QUESTIONNAIRE. THE RESULTS OF THIS QUESTIONNAIRE WILL BE HELD IN THE STRICTEST CONFIDENCE.

FIGURE 1

MAJOR SYSTEM ACQUISITION CYCLE

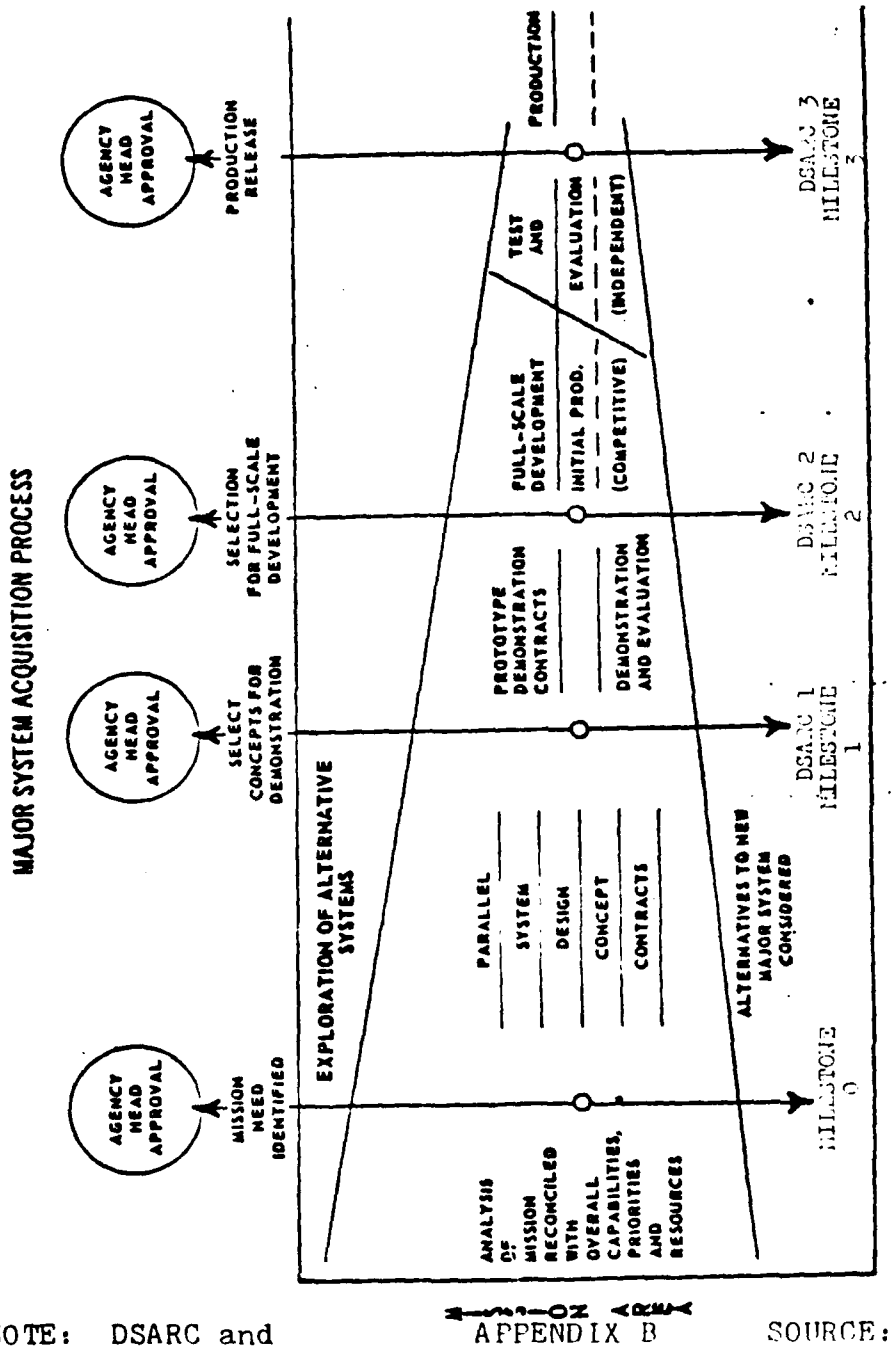


NOTE: DSARC and MILESTONE Information added by researcher

APPENDIX B

SOURCE: Reference 18

FIGURE 2



NOTE: DSARC and MILESTONE Information added by researcher

APPENDIX B

SOURCE: Reference 18

APPENDIX C

This appendix provides a chronological list of major energy and systems acquisition related legislation and other documents that have appeared in several reports by the General Accounting Office. [1,2] This information is provided for the interested reader and provides a chronological account of some of the legislation and regulations discussed in Chapter III. The legislation and regulations discussed in Chapter III are indicated with an asterisk (*).

Date	Public Law/ Regulation No.	Title
10 June 1920	66-280	Federal Water Power Act

This Act established the Federal Power Commission and had regulatory authority over certain water power projects.

21 June 1938	75-688	Natural Gas Act

This Act gave the Federal Power Commission jurisdiction over companies which transported and sold natural gas in interstate commerce.

16 Nov. 1973	93-153	Trans Alaska Pipeline Authorization Act

This Act directed the Secretary of the Interior to issue the necessary authorizations for construction of the trans-Alaska pipeline to carry crude oil from Prudhoe Bay to Valdez.

27 Nov. 1973	93-159	Emergency Petroleum Allocation Act

This Act directed the President to temporarily impose a mandatory allocation program for oil and oil products so that shortages resulting from the Arab Boycott would be shared by users.

Date	Public Law/ Regulation No.	Title
2 Jan. 1974	93-239	Emergency Highway Energy Conservation Act

This legislation provided that the Secretary of Transportation should not approve any interstate or defense highway project within a state that has a maximum speed limit on any of its public highways in excess of 55 miles per hour.

7 May 1974	93-275	Federal Energy Administration Act

This Act created the Federal Energy Administration as a temporary agency whose primary responsibility was to manage short term fuel shortages using allocation and price control authorities.

22 June 1974	93-319	Energy Supply and Environmental Coordination Act

This Act's main thrust was to temporarily delay certain clean air standards established under the 1970 Clean Air Act and directed the Federal Energy Administration to prohibit electric utilities from burning oil or natural gas if their facilities were capable of burning coal.

3 Sept. 1974	93-409	The Solar Heating and Cooling Demonstration Act

This Act authorized the appropriation of $60 Million over a five year period to develop solar heating and cooling systems for buildings to help decrease U.S. reliance on oil and to accelerate development of an alternative energy form.

*	22 Dec. 1975	94-163	Energy Policy and Conservation Act

The purpose of this Act was to increase domestic supplies and availability of energy, to restrain energy demand and to prepare for energy emergencies and other contingencies.

Date	Public Law/ Regulation No.	Title
* 5 April 1976	OMB Circular No. A-109	Major System Acquisition

This circular established policies to be followed by Executive branch agencies in the acquisition of major systems.

* 13 April 1976	Executive Order 11912	Energy Policy and Conservation

This Executive Order delegated authorities relating to Energy Policy and Conservation.

26 July 1976	94-370	Coastal Zone Management Act

This Act provided coastal states with funds to cope with the onshore impact (i.e., construction of public facilities) of off shore oil and gas exploration and production activities.

4 Aug. 1976	94-377	Federal Coal Leasing Amendments

This Act established new policies for leasing coal on Federal lands.

* 6 Aug. 1976	OFPP Policy Letter No. 76-1	Federal Procurement Policy Concerning Energy Conservation

This policy letter directed the Heads of Executive departments and establishments to ensure that the principles of energy conservation and efficiency were applied in the procurement of property and services whenever this application was meaningful, practicable, and consistent with agency programs and operational needs.

14 Aug. 1976	94-385	Energy Conservation and Production Act

This Act extended the life of FEA past its 30 June 1976 expiration date and contained provisions for programs to improve energy efficiency in commercial and residential buildings, assist in insulating housing of low income persons and improve electric utility rate designs.

Date	Public Law/ Regulation No.	Title
* August 1976	OFPP Pamphlet	A discussion of the Application of OMB Circular No. A-109

This pamphlet discusses the major systems acquisition process as presented in OMB Circular No. A-109 and implemented within DOD by DODD 5000.1 and DODI 5000.2.

* 18 Jan. 1977	DODD 5000.1	Major System Acquisitions

This DOD directive presents and discusses the process to be followed in major system acquisitions. Revised 19 March 1980.

* 18 Jan. 1977	DODI 5000.2	Major System Acquisition Procedures

This DOD instruction provides implementation procedures and discussion for the major systems acquisition process presented in DODD 5000.1. Revised 19 March 1980.

2 Feb. 1977	95-2	Emergency Natural Gas Act

This Act permitted the President to declare a natural gas emergency when he found that natural gas supplies were endangered for residential, small commercial and certain other users.

* 25 Aug. 1976 thru 9 Mar. 1977	DAR Council Discussions	Federal Procurement Policy Concerning Energy Conservation

Discussions by the DAR Council contained in DAR Case File No. 76-133 pertaining to Federal Procurement Policy and Energy Conservation.

* 29 April 1977	DAR Clause 1-339	Energy Conservation

This clause presents Federal Procurement Policy regarding Energy Conservation.

Date	Public Law/ Regulation No.	Title
20 July 1977	Executive Order 12003	Energy Policy and Conservation

This Executive Order delegated authorities relating to Energy Policy and Conservation.

4 Aug. 1977	95-91	Department of Energy Organization Act

This Act established a Department of Energy in the Executive Branch by the reorganization of energy functions within the Federal Government in order to secure effective management to assure a coordinated National Energy Policy and for other purposes.

3 Feb. 1978	Executive Order 12038	Energy Conservation

This Executive Order pertained to certain functions transferred to the Secretary of Energy by the Department of Energy Organization Act.

27 Mar. 1980	96-223	Windfall Profits Tax

The purpose of this Act is to recapture excessive revenues derived by the oil companies from the deregulation of domestic crude oil. It is part of the President's "Triad" legislation pertaining to the National Energy Plan that includes a Synthetic Fuels Bill and Energy Mobilization Board.

30 June 1980	96-294	Synthetic Fuels Bill
In Process	Senate Bill S-1308	Energy Mobilization Board

REFERENCES FOR APPENDIX C

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2. U.S. General Accounting Office, "National Energy Policy: An Agenda for Analysis," EMD-77-16, January, 1977.

APPENDIX D

2 April 1980

MEMORANDUM FOR MR. WILLIAM J. SHARKEY
DIRECTOR, ENERGY POLICY

SUBJECT: Progress Report on Task ML011, "Achievement of Safety and Energy Conservation in the Weapon System Acquisition Process"

This memorandum is the first progress report for LMI Task ML011 as called for in the task order. It provides a brief survey of the formal guidance presently promulgated by OSD and the Services which addresses, within the acquisition process, the energy consumption requirements of DOD's weapons systems and equipment. We have found that:

1. In many cases the appropriate OSD and military department directives have been or are being modified to reflect an increased management concern for the energy efficiency of weapon systems during the acquisition process.

2. In total, the guidance provided by these changes is very general and sometimes conflicting concerning the approach and methods to be used in treating energy efficiency.

3. Due to the lack of specific guidance, and a perceived lack of high priority, the Service staffs responsible for review of energy utilization during system acquisition now have little impact on system selection, design or development.

4. There are several existing, well developed acquisition concepts, including life cycle costing (LCC) and logistic support analysis (LSA), which could be modified and used to increase emphasis on system energy efficiency during the acquisition review process.

While there is currently considerable focus on energy usage in the Services, it is oriented mostly toward solving

the immediate problems of high energy costs and uncertain energy supplies for existing systems. Primary efforts, therefore, are directed at ways to reduce fuel usage in order to meet federal energy conservation goals and to stay within budgets without impairing operational readiness. Considerations of ways to reduce the energy consumption of DoD's weapons systems have tended to concentrate on procedural changes or on modifications to existing weapons systems. Relatively little attention has been directed to the issue of adjusting the design, selection, and development of new systems to improve their basic energy efficiency.

Listed below are the key documents promulgated by OSD and the Services to provide formal guidance with respect to energy consumption considerations in the acquisition process. The energy related sections of each document are summarized. A brief commentary based on our review of the document and interviews with OSD and Service staff members follows each document summary.

DOD DIRECTIVES AND INSTRUCTIONS

DoDI 5000.2 Major System Acquisition Procedures (Draft as of March 31, 1980)

This draft instruction states that

> "energy requirements shall be considered in system selection and design. Major considerations shall be minimal energy usage and the substitution of other energy sources for petroleum and natural gas."

Acquisition personnel in the three services believe that while these words will be of some help, in the absence of further

guidance they are too general and vague to significantly affect the acquisition process. This is especially true in the face of competing development decision criteria of cost, performance and schedule.

DoDD 4170.10 Energy Conservation (29 March 1979)

This response to federal energy conservation goals stipulates that DoD conservation efforts will be implemented without adversely affecting mission capabilities or readiness. It assigns OASD (MRA&L) the responsibility to establish conservation program goals for DoD, to develop procedures for monitoring their accomplishment, and to develop an overall plan for conservation in DoD. OUSDR&E is assigned responsibility to establish a program to improve energy efficiency in propulsion systems, both old and new. In addition, that office is charged to establish DoD policy to ensure that energy conservation is considered in the concept formulation, design, selection and production of weapons systems.

DoDD 4140.43 Department of Defense Liquid Hydrocarbon Fuel Policy for Equipment Design, Operation and Logistics Support (5 December 1975)

This directive is concerned primarily with the supply and availability of fuels. It mandates that the military departments achieve greater flexibility in the types of fuels used in military missions such that use can be made of a wider range of military and commercial fuels. This requirement is to be fulfilled by design of new power plants which incorporate the desired fuel flexibility.

The above three documents are the key OSD directives which provide explicit guidance concerning energy consumption. There are other directives which do not incorporate considerations of energy, but which might logically be revised to incorporate them explicitly. Examples of these are DoDD 5000.28--Life Cycle Cost Management Program, DoDD 5000.39--Integrated Logistics Support (ILS) Management, and DoDD 4105.62--Selection of Contractual Sources for Major Defense Systems.

U.S. ARMY

At present the Army has issued no formal guidance for energy consideration in the acquisition process. However, there are in circulation draft revisions to two Army Regulations (AR) which would include energy considerations in the requirements definition/acquisition process:

AR 1000-1 Basic Policies for Systems Acquisition (15 May 1978)

AR 71-9 Force Development Material Objectives and Requirements (1 April 1975)

The draft change to AR 1000-1 mandates that efficient use of energy will be a primary objective of energy dependent programs. It specifically states that energy requirements will be "a primary consideration in the exploration of alternative systems concepts, to include an evaluation of the performance, economic, and readiness impact of using alternative fuels/energy sources."

This change will be incorporated in AR 1000-1 subsequent to the promulgation of the current revised draft versions of DoDD 5000.1 and DoDI 5000.2.

We were not able to obtain a copy of the revised AR 71-9 for review.

U.S. NAVY

Four Navy instructions were found to be germane to the study:

OPNAVINST 4100.5A	Energy Resource Management (9 May 1978)
NAVMATINST 4100.16A	Energy Management (EM) Plan (12 October 1979)
NAVMATINST 5000.19B	Weapons Systems Acquisition Program Review and Appraisal within the Naval Material Command (21 February 1978)
NAVMATINST 5000.22A	Weapon System Selection and Planning (14 July 1977)

OPNAVINST 4100.5A requires that an energy effectiveness review should be incorporated in the system acquisition and planning process. It states that

> "All Navy systems in the program initiation, demonstration and validation, full-scale engineering development, and production and deployment phases will be subject to this review. The objective is to integrate energy consumption data as an element of operating and support cost in the Life Cycle Cost (LCC) and Design to Cost goals. These energy effectiveness reviews will include major systems, components, and subsystems within the acquisition process."

NAVMATINST 4100.16A implements OPNAVINST 4100.5A within the Naval Material Command. Its scope is broad and its guidance is no more descriptive or concrete than OPNAVINST 4100.5A with respect to the role of energy in the acquisition process.

A key responsibility for energy in the acquisition process within the Naval Material Command is the Assistant

Deputy Chief of Naval Material Acquisition for Acquisition Control. NAVMATINST 5000.19B promulgates the policy and procedures within which this organization operates. With regard to program review presentations before this group, it states that they

> "shall be structured to focus on the program status and projection, existing and anticipated deviations from the program plan, significant problems, and issues of concern. Areas which shall be addressed (as they apply to the nature and developmental phase of the program being reviewed) are:
>
> 1. mission profile/capability
> 2. performance objectives
> 3. reliability/maintainability goals
> 4. energy consumption goals"

Hence, energy "consumption goals" is a concept that is included in this management framework.

NAVMATINST 5000.22A contains no significant guidance with respect to energy consumption. However, this instruction will be revised subsequent to the promulgation of DoDI 5000.2, to help implement the specific energy related guidance contained in DoDI 5000.2.

Our interviews with Navy acquisition personnel indicated that despite the explicit requirement to integrate energy consumption data into acquisition decisions (as directed by OPNAVINST 4100.5A and NAVMATINST 5000.19B) there has been little success in carrying out this guidance. To some extent this has been caused by a lack of specific formal guidance from OSD and a minimal day-to-day management emphasis in this area. The general feeling is that while

management interest is high, decisions as to precisely how energy considerations will be integrated into the system acquisition decision process have not yet been made.

U.S. AIR FORCE

Several Air Force Regulations (AFR) relating to the role of energy in the acquisition process were found:

AFR 800-3	Acquisition Management: Engineering for Defense Systems (17 June 1977)
AFR 800-2	Acquisition Management: Acquisition Program Management (14 November 1977)
AFR 800-8	Acquisition Management: Integrated Logistics Support (ILS) Program (7 February 1980)
AFR 800-11	Life Cycle Cost Management Program (22 February 1978)
DAFHQ Operating Instruction 800-2	Acquisition Management: Program Management Direction

AFR 800-3 mandates that the Air Force Systems Command (or other implementing command) will ensure that the concept of energy effectiveness and the requirements of DoD's Liquid Hydrocarbon Fuel Policy (DoDD 4140.43, paragraph IV) be applied to all new engine developments. Energy effectiveness is defined in this regulation as the requirement for "the least critical energy investment, the widest range of energy use capabilities, or the most efficiency in terms of energy used." The regulation further states that "consideration should always be given to the potential impact of the decision (choice) on finite energy resources." This definition was first incorporated in AFR 800-3 in the form of a change on 25 February 1975.

AFR 800-2 implements DoDD 5000.1 and DoDI 5000.2. At present, it does not specifically address energy consumption. However, it will be revised to include some treatment of energy consumption subsequent to the promulgation of present drafts of OSD's 5000.1 and 5000.2.

AFR 800-8 was revised very recently (7 February 1980) to require that ILS planning reflect the most energy efficient support approach for a system through trade-off analyses, comparison to developed conservation goals, and performance of system modifications. Energy Management (EM) was explicity added as an ILS element in this revision even though it was not added as an ILS element in OSD's recently revised corresponding directive: DoDD 5000.39-Integrated Logistics Support Management. In this case the Air Force regulation appears to have gone beyond OSD guidance in providing specific requirements for the treatment of energy within the ILS framework.

AFR 800-11 (LCC Management) addresses weapon system energy consumption explicitly only in that Petroleum/Oils/Lubricants (POL) are included as a formal element (301.3) within the generalized cost element structure promulgated with the regulation. While this current treatment of energy is minimal, the regulation should be seriously considered as a vehicle by which a stronger emphasis and more explicit guidance with respect to energy effectiveness might be promulgated.

DAFHQ Operating Instruction 800-2 (Draft) provides direction for developing, coordinating, approving, and distributing the Air Force's Program Management Directive (PMD). The PMD is a contract between the Secretary of the Air Force (SAF) and the Acquisition Program Manager (PM). It plays the same role within the Air Force as the Decision Coordinating Paper (DCP) plays between the Secretary of Defense and the SAF. The Operating Instruction 800-2 draft states that:

> "the effort directed by this PMD must include careful and complete consideration of energy effectiveness in terms of optimum use of energy expended while continuing to meet the operational requirement. Energy effectiveness shall be a major management consideration, along with cost, schedule and performance criteria, in the development, acquisition and support of the effort directed herein."

This is the strongest statement we have found with respect to the role that energy effectiveness should play. While it is encouraging in one sense, it is not clear that it is either logical or useful to place energy effectiveness on the same footing as the basic decision parameters of performance, cost, and schedule, rather than integrate the concept of energy effectiveness within the established decision parameters. In addition, the draft instruction seems to be inconsistent with the policy set forth in the Air Force Energy Plan 1978 which states that energy actions will <u>not</u> be treated as a unique and special class, but rather "... all energy actions must be accomplished through

the established PPB system and that energy actions, however desirable, must compete with other programs for funding." Presumably this means that the usual criteria of cost vs. performance and schedule will prevail.

The documentation above indicates that there has been considerable effort, though at times uncoordinated and conflicting, to increase weapon system energy effectiveness within the Air Force acquisition process. However, interviews with Air Force acquisition personnel provide a picture similar to that found in the Navy: namely, energy effectiveness continues to have a low priority in Air Force acquisition decision making. It is likely to continue to be treated this way until more explicit guidance on ways to handle energy issues within the existing decision structures are defined and promulgated by OSD.

* * * *

The report of findings above completes work on item (a) of the LMI Task ML011, and establishes a point of departure for the accomplishment of item (b), the development of recommendations which can be taken to increase the emphasis on energy conservation in the acquisition process. Specifically, we will explore ways to integrate considerations of energy conservation into the array of existing acquisition tools and procedures; e.g. LCC and LSA, as suggested in finding number 4.

James B. Lessig

APPENDIX E

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

OFFICE OF FEDERAL
PROCUREMENT POLICY

POLICY LETTER NO. 76-1 August 6, 1976

TO THE HEADS OF EXECUTIVE DEPARTMENTS AND ESTABLISHMENTS

SUBJECT: Federal Procurement Policy Concerning Energy Conservation

Public Law 94-163, the Energy Policy and Conservation Act, establishes a number of Federal energy conservation measures, one of which is to promote energy conservation and efficiency through procurement policies and decisions of the Federal Government. Responsibility for this program was delegated to me by Section 3 of Executive Order 11912, April 13, 1976.

In the furtherance of this program, you are requested to ensure that the principles of energy conservation and efficiency are applied in the procurement of property and services whenever the application of such principles would be meaningful and practicable and consistent with agency programs and operational needs. These principles may be appropriate for application, along with price and other relevant factors, in the formulation of purchase requests and solicitations and during the evaluation and selection of bids and proposals. In addition, with respect to procurement of consumer products, as defined under Part B of Title III (42 U.S.C. 6291) of the Energy Policy and Conservation Act, agencies should take cognizance of energy use/efficiency labels (42 U.S.C. 6294) and prescribed energy efficiency standards (42 U.S.C. 6295).

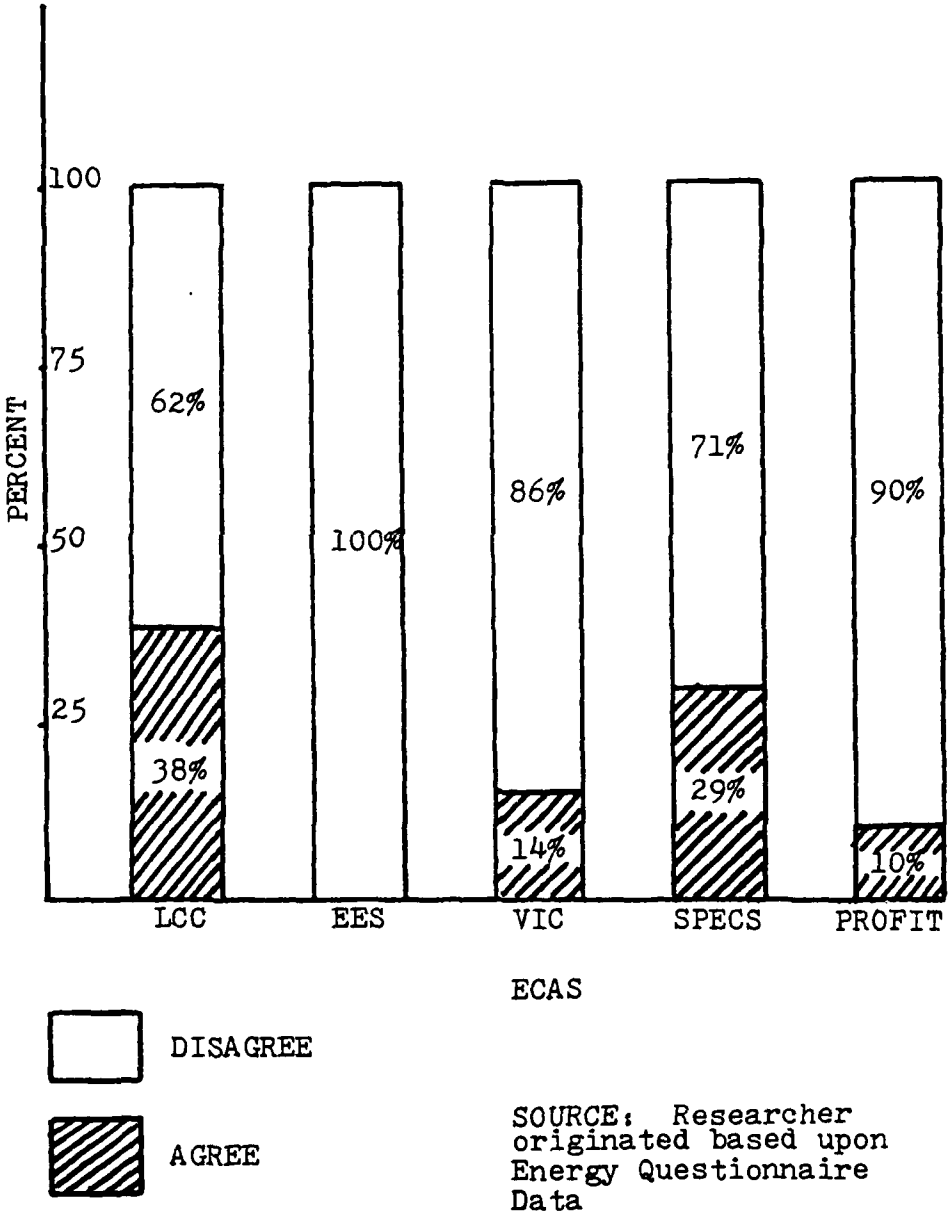
Specific procedural implementation of this policy will be promulgated in the Armed Services Procurement Regulation and the Federal Procurement Regulations.

Hugh E. Witt

Hugh E. Witt
Administrator

APPENDIX F

DOD UTILIZATION OF SELECTED ACQUISITION STRATEGIES
FOR ENERGY CONSERVATION AS
PERCEIVED BY INDUSTRY RESPONDENTS



SOURCE: Researcher originated based upon Energy Questionnaire Data

APPENDIX G

ESTIMATED FINANCIAL IMPACT
OF SELECTED ACQUISITION STRATEGIES
AS PERCEIVED BY INDUSTRY RESPONDENTS

FINANCIAL IMPACT (%)

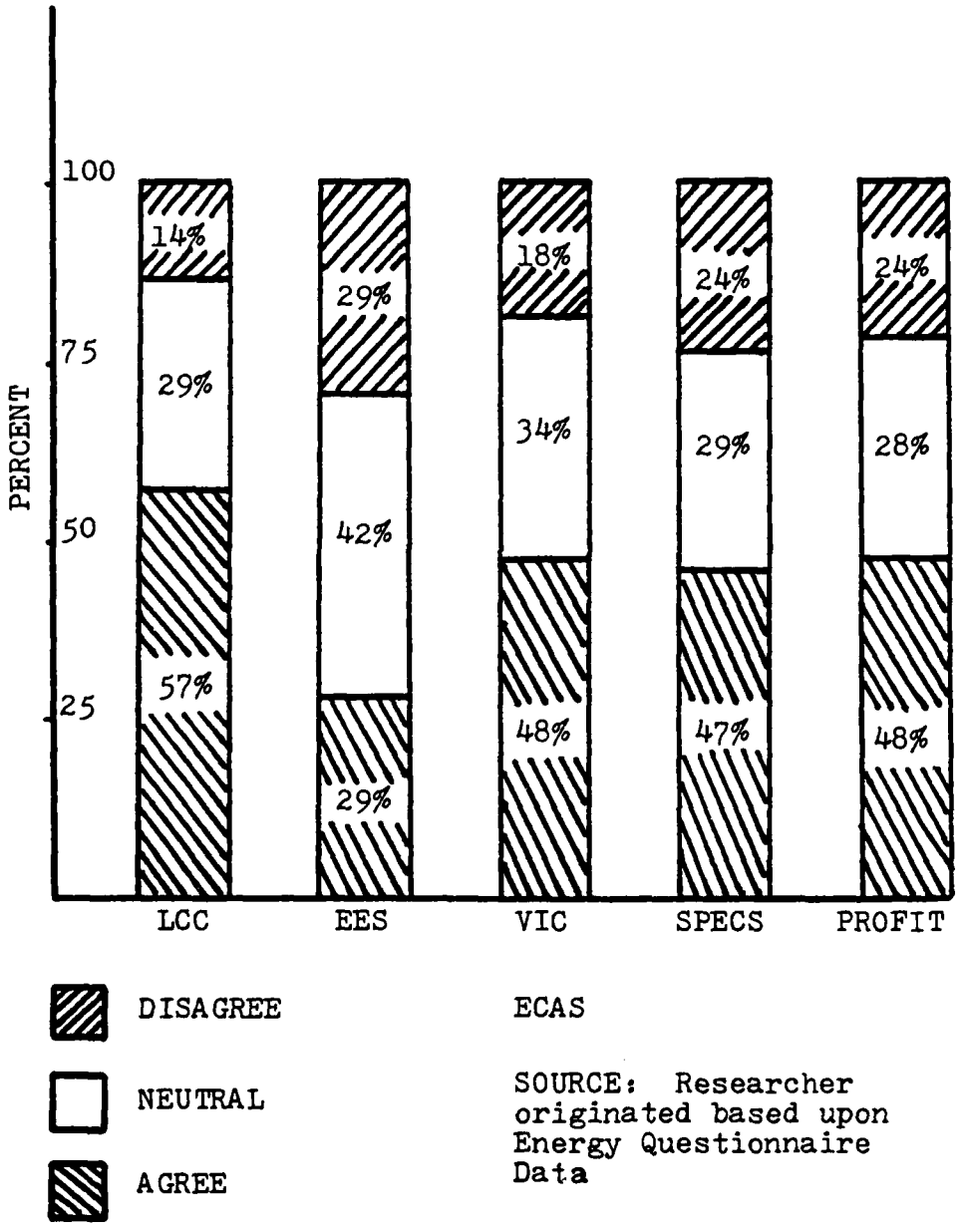
ECAS	DECREASE ← INCREASE →						MEAN
	0-(-1)	0	0-1	1-3	3-5	Above 5	
LCC	0	1	2	1	3	2	+2.78%
EES	0	0	1	2	1	1	+2.70%
VIC	1	0	3	0	3	0	+1.86%
SPECS	0	0	1	2	3	2	+3.31%
PROFIT	0	0	2	0	2	0	+2.25%

AVG. ECAS FINANCIAL IMPACT : +2.58%

SOURCE: Researcher originated based upon Energy Questionnaire Data

APPENDIX H

EFFECTIVENESS OF SELECTED ACQUISITION STRATEGIES
FOR ENERGY CONSERVATION
AS PERCEIVED BY INDUSTRY RESPONDENTS



ECAS

SOURCE: Researcher originated based upon Energy Questionnaire Data

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